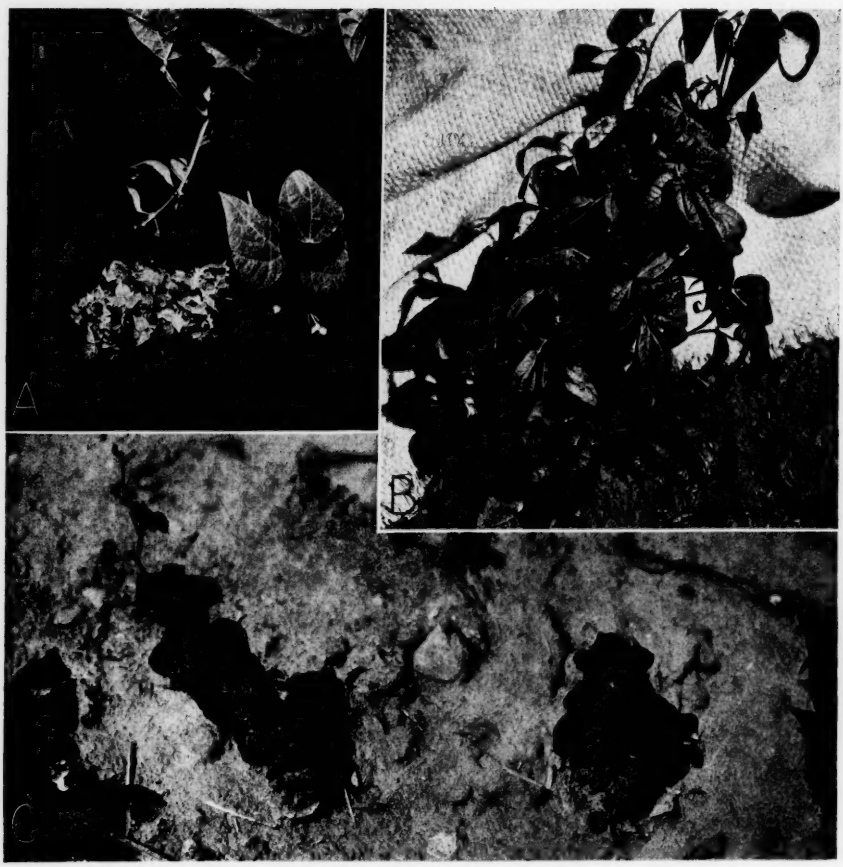
The Journal of HEREDITY



MUTANT BEAN PLANTS PRODUCED BY X-RAY
(SEE PAGE 39)

Pedigrees of Human Cancer

Shell Finish Genes

A Hybrid Maple

VOLUME 32 JANUARY, 1941 NUMBER 1

The American Genetic Association

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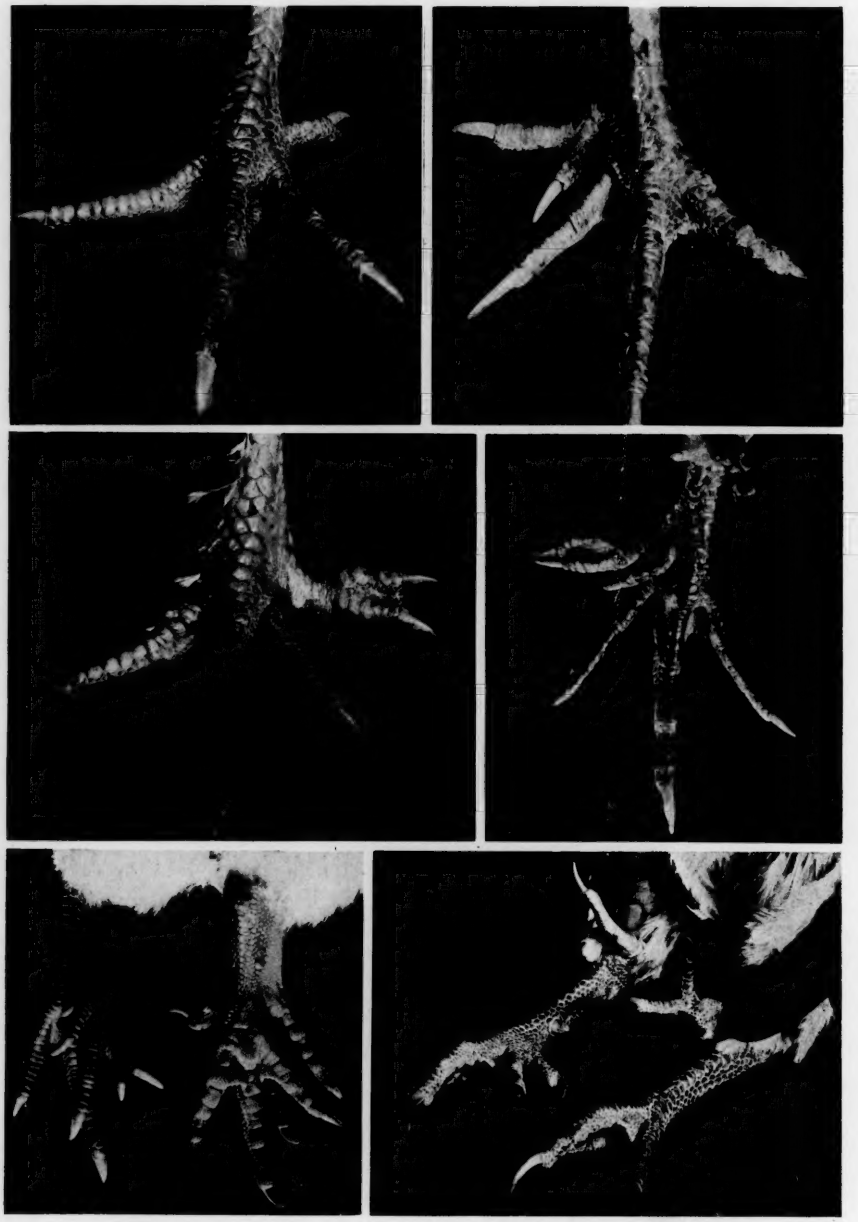


TYPES OF POLYDACTYLY IN THE "DUPLICATE" STOCK

Frontispiece

A—Normal non-polydactylous foot. *B*—The type of polydactyly usually found in polydactylous breeds. *C*—A common type found in homozygous duplicates; note that it appears like *D* with the normal No. 1 toe missing. *D*—A six-toed type common in duplicate. *E*—An extreme variant of duplicate which deforms the chick to a lethal degree. *F*—Another extreme variant of duplicate.

A NEW TYPE OF POLYDACTYLY IN THE FOWL*

D. C. WARREN

A NEW type of polydactyly was found in a flock of White Leghorns by an inspector of the Kansas Poultry Improvement Association in 1935. It was the only case of polydactyly observed among over 200 normally four-toed individuals in the flock. Since the variation has been shown to be a dominant it is possible that the mutation occurred in this bird. The polydactylous bird was a female that showed only the characteristics of her breed, indicating that she was not the result of crossbreeding with some polydactylous breed. She was found to be heterozygous for the factor.

The variation has been given the name "duplicate" because of the apparent doubling of the foot and shank in some extreme individuals. There is rather wide variation in the expression of the character and in some birds it is indistinguishable from the five-toed condition which is characteristic of certain breeds of fowl (Frontispiece *A*). However, this type of polydactyly is found relatively infrequently in the duplicate stock. The usual type (Frontispiece *B*) found in polydactylous breeds has the superficial appearance of a toe with an extra joint being added just inside the short inside No. 1 toe. It is this short inside No. 1 toe that is affected in polydactylous fowls. The more usual expressions of duplicate are the six-toed condition (Frontispiece *D*) and the five-toed condition where the normal No. 1 toe seems to be absent and the long extra toe shows varying degrees of splitting (Frontispiece *C*). The six-toed type shows a normal No. 1 toe and a split extra toe. There was frequent asymmetry in the two feet with respect to the presence or absence, or type, of polydactyly.

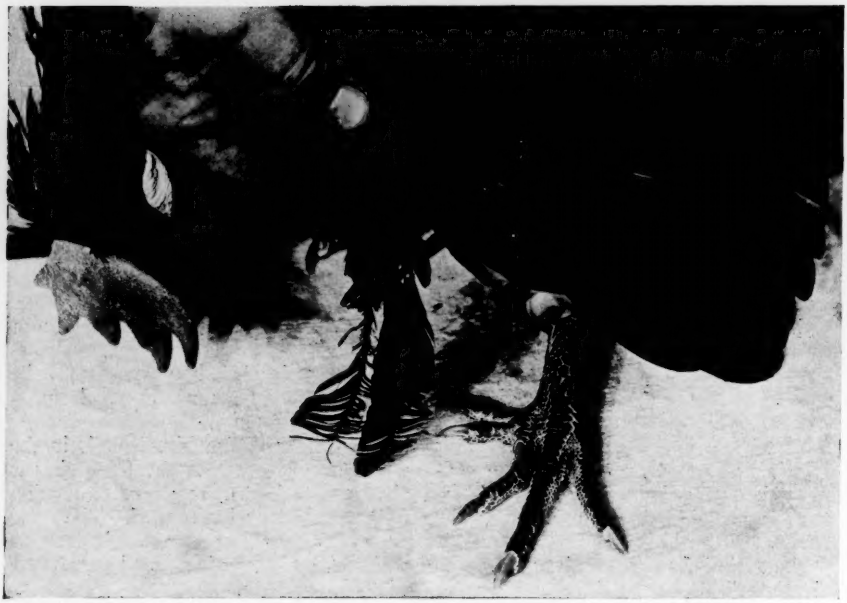
In the more extreme variants the foot is normal and the extra toes are along the shank, sometimes as high as the hock joint (Frontispiece *F*). An extreme case is shown in Frontispiece *E* where there appears to be almost a complete duplication of the foot and shank. Extreme cases of this type usually act as a lethal in so deforming the chick that it cannot survive. The two extreme types usually appear only in birds homozygous for the factor. Another manner in which duplicate differs from ordinary polydactyly is a doubling of the No. 1 digit in the wing to a degree that the feathering is abnormal and sometimes causes the wing to be conspicuously drooped. The wing deformity shown in Figure 1 is variable and noticeable only in a small percentage of the duplicates.

Variants of the type shown in Frontispiece *C* are most common in homozygous birds but some six-toed birds (Frontispiece *D*) also have proved to be homozygous.

In Table I are given the results of various types of matings of duplicate. A large amount of data involving back crosses of birds heterozygous for duplicate to normals are included since in this type of mating linkage tests were made of the factor. The almost perfect 1:1 ratio from this back cross demonstrates that duplicate is due to a single dominant factor. The mating of a homozygous duplicate with a heterozygous bird produced two normals out of 144 individuals indicating that an occasional bird carrying the factor for duplicate appears normal. This condition has frequently been observed in the ordinary type of polydactyly in the fowl. Detailed results not given in the table show that the gene "duplicate" is autosomal in location.

The data from the cross of heterozygous duplicate to heterozygous polydactyly (line 5, table I) throw some light on the relationship between these

*Contribution No. 136, Department of Poultry Husbandry, Kansas Agricultural Experiment Station.



WING ALSO POLYDACTYLOUS
Figure 1

A bird showing the duplicate type of polydactyly in the foot and its expression in doubling the No. 1 digit of the wing.

two factors. If they are two independent genes, the ratio of all types of polydactyly to normal should be 15:1 while if the two genes belong to a multiple allelomorphic series, the resulting ratio should be 3 polydactyls to 1 normal. With a total of 185 offspring from this mating the actual ratio of polydactyls to normal was 142 to 43. On the assumption that the two factors are on different chromosomes, the expected ratio should be 173 polydactyls to 12 normals while if they belonged to a multiple allelomorphic series it should be 139 polydactyls to 46 normals. The latter expectation is much nearer the actual ratio than the former and indicates that duplicate and the usual type of polydactyly may belong to a multiple allelomorphic series, and that the two constitute different changes in the same gene.

In the cross of homozygous duplicate to heterozygous duplicate 95 individuals had the same type of polydactyly on each foot. They were classified as 37 with six toes (Frontispiece *D*); 33 with five toes but showing a split long inside toe (Frontispiece *C*); 21 with five toes like

Table I. Results of various types of matings of duplicate.

Type of Mating	Polydactyls		Normals		Total	
	Females	Males	Females	Males	Polydactyls	Normals
Homozygous duplicate by normal	49	38			87	
Heterozygous duplicate by heterozygous duplicate	62	53	6	10	115	25
Heterozygous duplicate by normal	422	466	423	488	888	911
Heterozygous duplicate by homozygous duplicate	75	67		2	142	2
Heterozygous duplicate by heterozygous polydactyly	78	64	21	22	142	43

the usual type of polydactyly (Frontispiece *B*); and three others which failed to fall in these classifications. The asymmetrical types of polydactyly were not included in the foregoing data because of difficulty of classification but the results indicate the relative incidence of the types of polydactyly in duplicate stock. A mating of males and females each homozygous for duplicate produced only a few offspring but a considerable amount of variability in type of polydactyly occurred indicating that that found in the foregoing mating was not due to the fact that it produced both heteozygous and homozygous offspring.

The tabulated results would indicate that duplicate behaves genetically as an autosomal dominant. In the expression of polydactyly it differs from the type of characteristic of certain breeds of chickens. Preliminary results suggest that duplicate may be a member of a multiple allelomorphic series along with the usual type of polydactyly.

◆

QUINTUPLET-BEARING GOATS BACK TO NORMAL

IN 1938 we noted in the JOURNAL a remarkable instance of fecundity in goats. This was reported by Mr. Roscoe F. Patt of West Leesport, Pennsylvania. A doe in his herd of milk goats gave birth to three consecutive sets of triplets in 1934, 1935 and 1936, and then in March 1937, she raised the ante to quintuplets, a feat which she repeated just a year later. In five years she had given birth to nineteen offspring—a truly remarkable record. Several other instances of above average fecundity also had occurred in Mr. Patt's herd. He wrote that he was attempting to develop a herd of goats having a higher proportion of multiple births than is normal in the milk goat breeds.

With commendable scientific interest Mr. Patt has faithfully kept his promise to report the results of his project. His scientific attitude is all the more noteworthy because since 1938 the fecundity of the herd has not risen noticeably above that of the breed in which twins are by no means uncommon. Normally in milk goats twins of opposite sex do not suffer from the developmental conflicts which produce free-martins in cattle. It is perhaps significant that among the quintuplets reported earlier a situation similar to free-martinism seems to have existed. Mr. Patt's letter is as follows:

The goat quintuplet family which you considered of sufficient interest to note in your January, 1938, JOURNAL have now produced several sets of kids and you may possibly find the results of interest.

After bearing three sets of triplets the little doe produced quints in March 1937 and a second set of quints in March of 1938. Though apparently perfectly healthy, she died in the autumn of 1938 of some digestive poisoning.

The '37 set never produced young. The four males were castrated and the female proved quite conclusively to be the caprine equivalent of a freemartin of cattle twins of opposite sex. Although she came in heat from the early winter of 1937 at regular intervals until 1941 and was mated just as regularly, she failed to conceive. The ratio of four males to one female and the inevitable overcrowding of the foeti of such an abnormally large litter could easily have caused fusion of the blood streams and introduction of the earlier developed and incompatable male hormones.

The '38 quintuplets all proved fertile, their record is as follows:

3 Does — 2 Bucks

No. 1 Buck

Mated to Doe No. 3 produced single doe in Spring of 1939.

No. 2 Buck

Sold to lead a small herd. Has only produced the usual singles and twins. No complete data but no multuplets.

No. 3 Doe

Mated to Buck No. 1 (above)—
1 single, doe, Spring 1939.
Mated to Sire—
Twin does, Spring 1940.
Mated to Sire—
Mated to unrelated Buck—
Twins, 1 doe, 1 buck, January, 1941.

No. 4 Doe

Mated to Sire—
1 single, buck, Spring 1939.
Twins, 1 doe, 1 buck, Spring 1940.
Mated to Sire—
Triplets, 1 doe, 2 bucks, January 1941.

No. 5 Doe

Mated to Sire—
1 single, buck, Spring 1939.
Mated to Sire—
Twins, 1 doe, 1 buck, Spring 1940.
Mated to Sire—
Twins, 2 bucks, January 1941.

Doe from Mating of Quintuplets
No. 1 and No. 3 above
Mated to Grandsire—
Twin bucks, Spring 1940.
Mated to Grandsire—
Twin does, December 1940

The above will average almost exactly the normal dairy goat average of twins of opposite sex. I suppose the conclusions may be drawn that in this case multuplet production is not inherited. The one mating required to round out the data i.e. the mating of the dam to one of her quintuplet sons is unfortunately not possible.

◆

ACENAPHTHENE AND COLCHICINE

My experiments confirm to a great extent the opinion of Kostoff that in its effects on mitosis acenaphthene is comparable to colchicine. The negative results with acenaphthene, which have sometimes been reported, must be due either to a special immunity of the experimental plants employed or, more likely, to an erroneous technique. The latter explanation has been suggested by Kostoff. Differences in the effect of acenaphthene occur, however, in identical material as compared with the effect of colchicine. Thus, acenaphthene acts decidedly more slowly in *Allium* than colchicine. It takes perhaps 1,000 times longer to obtain the maximal effect with acenaphthene than with colchicine. The reason of this may be found in the very low degree of solubility of acenaphthene in water, which necessarily retards its absorption in the cell sap. If this is the case, perhaps the external parts of the tissue should be affected first, and this could not be demonstrated in my experiments. The affected cells were found intermingled among normal cells all through the tissue.

On the other hand, the similarity of action between acenaphthene and colchicine is striking. And the final stage of the effect, the completely formed c-pairs, is identical in both cases. The acenaphthene effect, as it appears in *Allium*, may consequently be regarded as an ultra-rapid exposure of colchicine action. And this condition involves, as has been pointed out earlier, a great advantage for the detailed study of the course of the chromosome disturbances. * * *

Great as the advantage of this condition is theoretically, it is equally disadvantageous from a practical viewpoint, when it comes to inducing polyploidy. Kostoff emphasizes the lack of poisonous effect of acenaphthene as an advantage, as compared with colchicine. This advantage is unfortunately diminished by the slowness in action of the acenaphthene, which must cause a predisposition to the origin of aneuploid cells. Such cells are of course under all conditions formed during the recovery stage. Colchicine, too, gives a slow and fractioned recovery process, during which all kinds of spindle disturbances are found.

It may be mentioned, however, that these conditions have been studied by me in detail only in *Allium*. It is therefore probable that other plants may exhibit another reaction, and will perhaps be to the advantage of acenaphthene in inducing polyploidy. This is of course the case under such special conditions as in *Colchicum*, which is immune to colchicine [but highly susceptible to acenaphthene]. According to Blakeslee the fungi are immune to colchicine. In other cases perhaps organisms are found to be hypersensitive to colchicine, so that even small doses cause lethality. Here, too, the less poisonous acenaphthene will be appropriate. It thus follows that from a practical viewpoint it must be important that comparative treatments with different accessible substances are carried out in order to make sure in each case which substance is the most suitable one for the kind of organism under examination. * * * *

It is impossible at present to decide if the effect of acenaphthene is really identical with the effect of colchicine. The experiments with *Colchicum* show that the same spindle apparatus can be immune to one of these substances and susceptible to the other. The possibility touched upon in the introduction, that colchicine and acenaphthene may act upon two different part-functions, both necessary for a normal spindle function, certainly diminishes in probability at the same time as the course of the c-mitoses caused by the two different substances are in detail similar morphologically to each other. * * * *—Levan, Albert, *Hereditas* 16:273-275. 1940.

FAMILIAL TRENDS IN HUMAN CANCER

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THIS study, dealing with 438 individuals and their families, is an effort to determine the number of cancer-bearing persons in these families and the possible relation of such information to cancer in families generally. The impression that intestinal cancers tend to follow certain family trends is also tested from the statistical standpoint.

There are those who have maintained, sometimes without adequate statistical data, that cancer followed certain familial trends, even asserting that it was transmitted from parent to child through several generations. There are others who have maintained just as firmly that the occurrence of cancer in parent and child was purely incidental and of no importance when considered from the hereditary standpoint. To test the validity of either of these assertions we have collected data on three series of persons of similar age groups who presented themselves for examination during a given period and whose circumstances of living seemed entirely similar. A very thorough review of the literature on this important subject together with a clear and comprehensive analysis of the possibilities of the inheritability of cancer was made by Julius Bauer in his Middleton Goldsmith Lecture before the New York Pathological Society in 1932.

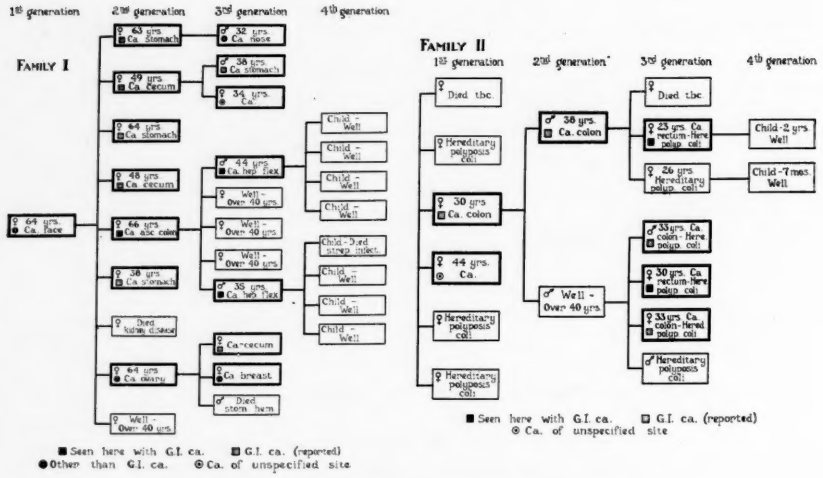
Cancer and Control Families

We are frankly aware of the difficulties encountered in any study of human relationships and their bearing on the transmission of disease processes. However, some facts are at hand which appeared so striking that their recording seemed worth while. The admission of the presence of cancer in the family by a patient is usually not one which is taken lightly.

The actual figures recorded may not be taken as statistically exact, for at times the information about the presence of cancer in a parent or grandparent was obtained solely from the patient examined, but rather as denoting what we believe is a definite tendency in the behavior of familial cancer, with special reference to cancer of the large intestine.

In all, 176 patients with proved cancers of the large intestine were followed, in whose families the incidence of cancer was marked. The cases were studied not with reference specifically to the presence of gastro-intestinal cancer in the family, but for the presence in relatives of cancer of any part of the body, including cases of cancers of unspecified site. The information was obtained in many instances by personal observation of several members of a family having cancer, and was also supplied in part by the patient, his relatives or his family physician. We have attempted, however, to standardize our findings in this group by comparison with two equally uncontrolled groups of patients, in the taking of whose histories the interrogating physicians were equally diligent, and the patients themselves equally intelligent and informed about the details of their family histories as those of the 176 individuals just mentioned.

Three groups of patients and their relatives observed at the Mayo Clinic were studied. The three groups comprise (*A*) 176 patients treated on the


1st generation
2nd generation
3rd generation
4th generation
FAMILY I
♀ 64 yrs. Ca. face
♀ 63 yrs. Ca. stomach
♀ 49 yrs. Ca. cecum
♀ 44 yrs. Ca. stomach
♀ 48 yrs. Ca. cecum
♀ 46 yrs. Ca. asc. colon
♀ 38 yrs. Ca. stomach
♀ Died kidney disease
♀ 64 yrs. Ca. ovary
♀ Well - Over 40 yrs.
♂ 32 yrs. Ca. face
♂ 38 yrs. Ca. stomach
♀ 34 yrs. Ca.
♂ 44 yrs. Ca. hep. flex
♀ Well - Over 40 yrs.
♀ Well - Over 40 yrs.
♀ Well - Over 40 yrs.
♂ 35 yrs. Ca. hep. flex
♀ Ca. cecum
♀ Ca. breast
♂ Died stom. hem.
Child - Well
Child - Well
Child - Well
Child - Well
Child - Died stomp. infect.
Child - Well
Child - Well
Child - Well
■ Seen here with G.I. ca. ▣ G.I. ca. (reported)
● Other than G.I. ca. ⊛ Ca. of unspecified site
FAMILY II
1st generation
2nd generation
3rd generation
4th generation
♀ Died tbc.
♀ Hereditary polyposis coli
♀ 30 yrs. Ca. colon
♀ 44 yrs. Ca.
♀ Hereditary polyposis coli
♀ Hereditary polyposis coli
♂ 38 yrs. Ca. colon
♂ Well - Over 40 yrs.
♀ Died tbc.
♀ 23 yrs. Ca. rectum-Here. polyp. coli
♀ 26 yrs. Hereditary polyp. coli
Child - 2 yrs. Well
Child - 7 mos. Well
♂ 33 yrs. Ca. colon-Here. polyp. coli
♀ 30 yrs. Ca. rectum-Here. polyp. coli
♀ 33 yrs. Ca. colon-Hered. polyp. coli
♂ Hereditary polyposis coli
■ Seen here with G.I. ca. ▣ G.I. ca. (reported)
⊛ Ca. of unspecified site

CANCER THROUGH THREE GENERATIONS
Figure 2

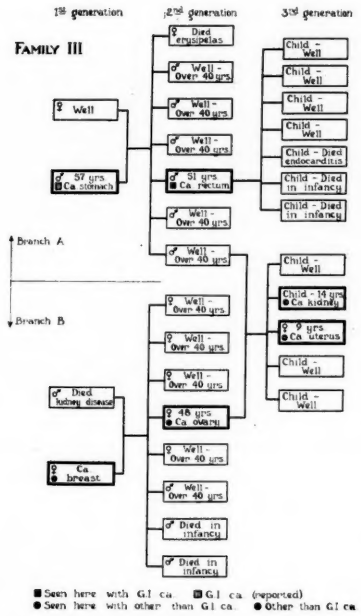
In Family I twenty-nine individuals are recorded; twelve are more than forty years of age; fifteen had cancer. In Family II seventeen individuals are recorded; only two are forty years of age or more; nine had hereditary polyposis and of the nine, four also had carcinoma; two others had carcinoma of the gastro-intestinal tract and another had carcinoma of an unspecified site.

enterologic services for proved carcinoma of the large intestine; (*B*) a control group consisting of 176 patients observed in the years 1931 to 1936, inclusive, for whom a diagnosis of hypertrophic arthritis was made, but in whom carcinoma was not found; and (*C*) a group consisting of the eighty-six patients with proved carcinoma of the kidney observed in the years 1910 to 1939, inclusive, for whom a history of cancer of other members of the family could be elicited. Some idea of the magnitude of the inquiry into behavior tendencies of familial cancer may be obtained from the fact that this third small group of eighty-six patients with renal cancer was derived from more than 700,000 individuals registering during the thirty year period and represented only 10 per cent of the cases of renal cancer.

The relatives of these three groups of patients were then divided into two groups: (1) those in whom cancer was affirmed to have been present and (2) those for whom no available information of its presence was at hand.

Those relatives in whom cancer was affirmed to have been present were further divided into three groups, dependent on the alleged site of the cancer: (1) cancer in the stomach or large intestine; (2) cancer of specified site elsewhere; and (3) cancer of unspecified site. If any doubt was indicated in the statement of the informant as to the actual existence of the cancer in other members of the family, such instances were classed in the group of relatives who were without cancer. If any doubt as to the site of the cancers of the relatives was expressed, but the actual presence of the cancer itself affirmed, the case was included in the subdivision of relatives with cancer of unspecified site.

Table I summarizes the data for those relatives who are said to have had cancer. The figures do not include the patients seen here with known cancer. From a perusal of this table several



CANCER OF VARIOUS ORGANS

Figure 3

Family III has noticeably less cancer of the gastro-intestinal tract than either of the other families charted (Figure 2).

points immediately impress themselves. The number of relatives with cancer of unspecified site is of the same order of magnitude, roughly, a quarter, for all three groups. In the two control groups, *B* and *C*, cancer of the gastro-intestinal tract and cancer of specified site other than the gastro-intestinal tract occur in the cancerous relatives roughly in the proportion of one to two.

The conformity of these figures supports our belief that the three groups are uncontrolled to such a comparable degree that the evidence for a specific behavior tendency of gastro-intestinal cancer as it appears in the relatives of the first group, *A*, is reasonable and warranted. Bauer* and others have spoken of this tendency as an "organ susceptibility" to cancer.

In this group, which consists of cancerous relatives of the 176 patients seen at the clinic having proved cancer of the colon and rectum, the incidence of cancer of the stomach, colon and rectum was more than half again as large as in the two control groups. Forty-two per cent of these cancerous relatives had such gastro-intestinal cancers, as compared with the mean incidence of 27 per cent of gastro-intestinal cancers found in the cancerous relatives of the two control groups.

Striking Group Differences

Again, it must be emphasized that these figures are not exact, but they differ widely enough from each other so that a definite tendency is indicated in the behavior of familial cancer of the colon and rectum. This tendency may be summarized as follows: When multiple cancers occur in any family and one cancer at least is localized in the colon or rectum, there is an appreciably greater chance that cancers in other members of

Table I. Distribution by Site of Cancer in Cancerous Relatives of 438 Patients

	Total relatives with cancer	Percentage distribution		
		In gastro-intestinal tract	Other than gastro-intestinal tract	Unspecified site
A: relatives of 176 patients having carcinoma of the colon and rectum	290	42	36	22
B: relatives of 176 patients having hypertrophic arthritis	57	25	50	25
C: relatives of 86 patients having cancer of the kidney	104	29	48	23

Table II. Incidence of Cancer in all Relatives

	Total relatives more than 40 years of age (with and without cancer)	Total relatives with cancer	Per cent with cancer
Relatives of patients having carcinoma of the colon	1108	290	26
Relatives of patients having hypertrophic arthritis	1033	57	6
Relatives of patients having carcinoma of the kidney	471	104	22

*BAUER, JULIUS. Genetics in cancer. (Middleton Goldsmith Lecture, New York Pathological Society, October 12, 1932), Lancaster, Pennsylvania, Lancaster Press, Inc., 1934, 21 pp.

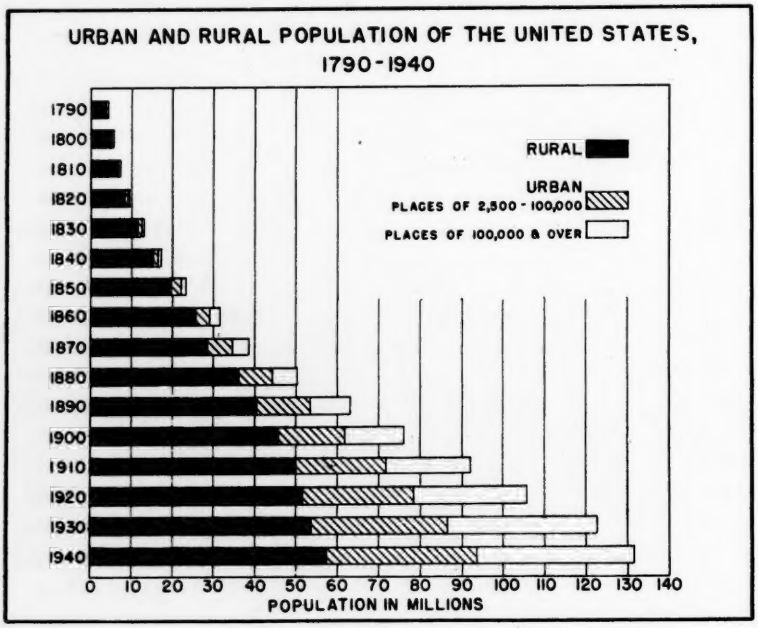
the family will be localized in the colon, rectum, and also in the stomach than occurs in cancerous families in which colonic and rectal cancer is not known to exist.

Table II illustrates the greater incidence of cancer in families of patients having cancer of the intestine than of those having hypertrophic arthritis.

Three family trees are presented in diagrammatic form in Figures 2 and 3. The large incidence of gastro-intestinal cancer in family I is to be noted. It is also of interest that the mother with carcinoma of the ascending colon has two sons, both of whom have carcinoma of the hepatic flexure of the colon. Her three daughters to date are free of cancer. The relative absence of gastro-intestinal cancer in family III is also of some interest.

A review of these 176 families indicates certain trends. The picture presented by families I, II and III has been repeated many times.

Too many factors are concerned in human family relationships to make it possible to arrive at any conclusion as regards the transmission of cancer from generation to generation. However, it may be said that the children of a person in whom cancer of the intestine develops have a greater tendency, if they live long enough, for a similar condition to develop in the intestinal tract than do those children both of whose parents were free of malignant disease.



Population Association of America

A RED MAPLE, SILVER MAPLE HYBRID

OLIVER M. FREEMAN

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IN the spring of 1933, it occurred to the writer that our two native maples, red maple, *Acer rubrum*, and silver maple, *A. saccharinum*, might be closely enough related to hybridize. It was noted that in the vicinity of Washington, D. C., red maple flowered about two weeks later than the silver maple. However, the blooming periods overlapped a few days in normal years so that the silver maple discharged pollen from the late flowers when early pistillate flowers of the red maple were apparently in a receptive condition. A search of fields and thickets where both species were growing, failed to show any evidence of natural hybrids.

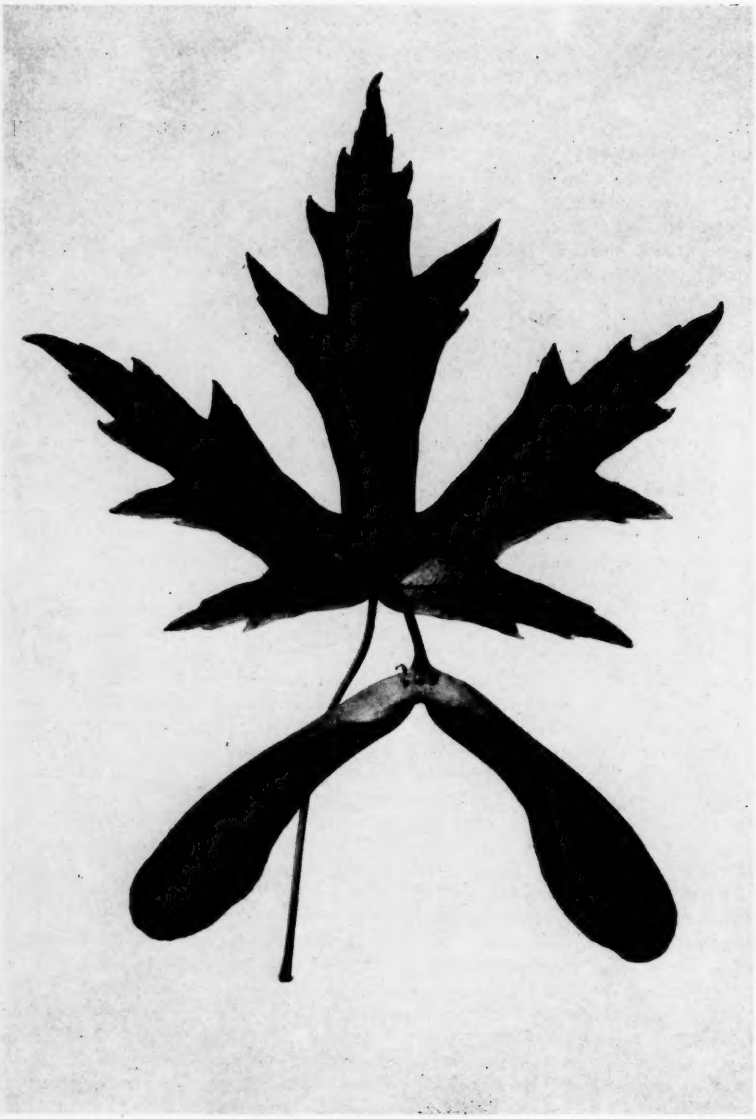
Because of the earlier time of blooming, the silver maple was chosen as the pollen parent. The staminate tree selected was about 25 years of age and appeared typical for the species. (See Figure 4.) Pollen was collected during the last week in February and placed in gelatine capsules which were stored in corked vials in a refrigerator. Typical trees of red maple bearing only pistillate flowers were selected at the National Arboretum. Conveniently located branches of these trees were covered with paper bags to avoid any chance of wind- or insect-pollination. These covered branches were examined frequently and when the pistils were fully expanded and appeared receptive, pollen of silver maple from the gelatine capsules was applied to the stigmas.

The paper bags were removed after ten days when it was obvious that many fruits were beginning to form. Three bags covering about 150 flowers which were not pollinated failed to set any fruits.

The fruits matured in about six weeks and were sown immediately. Germination required only a few days, after which the young plants were potted in thumb pots and later repotted to three- and four-inch sizes. During May of the following year (1934) the seedlings were set out in a nursery where they have continued to grow since.

To determine the relative rates of growth, seeds of both red and silver maple were grown and treated in the same manner as the hybrids. The hybrids made much faster growth than the red maple, but did not equal the rapid growth of the silver maple. Both the red and hybrid maples probably need more moisture than the silver maple which perhaps accounts, in part, for the difference in the rates of growth. As was to be expected, the variation among the seedlings is considerable. The form of growth, leaf type, and rate of growth show a wide variation. Most of the plants show a greater density of foliage than either of the parents. A few of the hybrids have two holes in some of the leaves caused by failure of tissue to close completely the deep sinus which is characteristic of the silver maple. (See Figure 5*C*.) One seedling is of a columnar type, as in Figure 6*A*. If this form is retained it may have value where a narrow tree is needed for landscape effect. A broad pyramidal type with dense foliage is shown in Figure 6*B*. Some of the hybrids have an interesting fall coloring of reds and yellows, but no specimen has shown the intense red of some of the red maples.

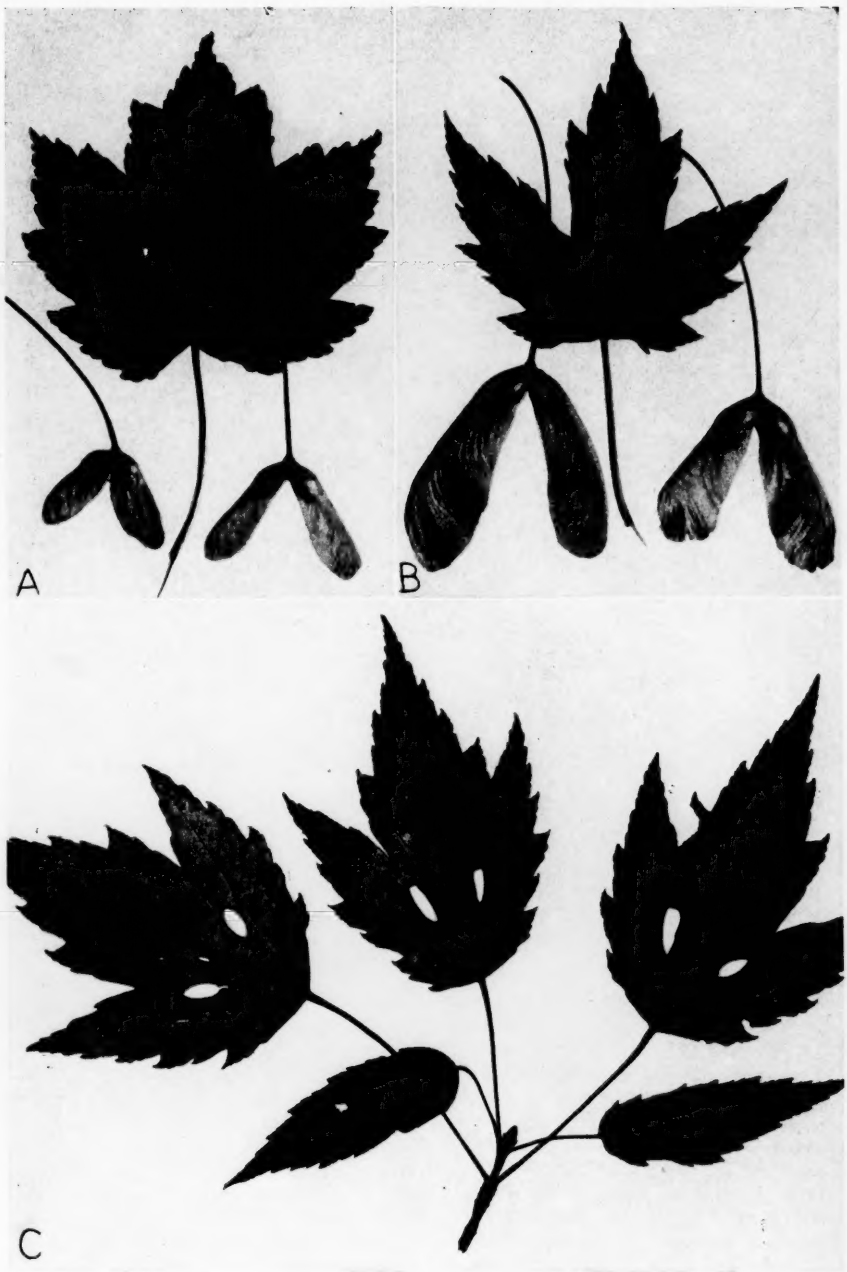
None of the hybrids flowered until March 1939, when there were from few to many blooms on 14 of the 41 plants. Ten of these were staminate and the others pistillate. In Figure 5*A* is a typical red maple leaf with two fruits from different trees, and in Figure 5*B*, is a leaf with fruits of the hybrid. It is interesting to note that, although the various forms of red maple have chromosomes numbering 36, 54, or 72, silver



THE POLLEN PARENT

Figure 4

Leaf and fruit of silver maple, natural size.



SEED PARENT AND HYBRID

Figure 5

Typical leaves and fruits of (*A*) the Red Maple (*Acer rubrum*), the pollen parent of the hybrid; and (*B*) of the hybrid. *C* shows leaves of one of the hybrids having holes in leaves due to failure to close fully the deep sinuses of the silver maple. All photographs natural size.

GROWTH HABIT OF THE HYBRID

Figure 6

A shows a hybrid tree with a distinctly columnar habit of growth. *B*, a hybrid tree of a broad pyramidal growth habit. The columnar tree is staminate and easily propagated, both desirable characteristics in an ornamental tree.

maples have 26 chromosomes and the hybrids produce apparently normal viable seeds. However, from several thousand flowers only a few dozen normal fruits were produced. This indicates a strong incompatibility which is occasionally overcome in some manner not yet fully understood.

The columnar specimen previously referred to is a staminate plant and was found to propagate easily from greenwood cuttings. Both of these factors are important for a maple to be used in ornamental plantings.

The writer hopes to be able to reverse this cross to find out whether the results will be identical. Some second-generation hybrids are being grown this year. This is to be considered as a preliminary report. A full report can be made only after more of the hybrid seedlings have flowered and fruited and an opportunity has been given to count chromosome numbers of the plants involved.

THE NEO-HAWAIIAN--A RACE IN THE MAKING

A Review

THE melting pot fires of Hawaii burn so fiercely that racial lumps of mankind having the highest melting points slump and fuse with the greatest of ease, forming amalgams to an extent undreamed of in the Continental United States where the "melting pot" signifies the mixing of Caucasian subgroups only.

The extent to which racial fusion has progressed in Hawaii was assayed in a study program by the University of Hawaii on the character of the peoples of Hawaii and their social relations. Romanzo Adams has used these data to sample the hybrid origin of this incipient race. The account* of his conclusions makes most interesting reading.

In 1779 there were about 300,000 souls in the Paradise of the Pacific. Sword and pestilence had drastically reduced the population by 1804. By 1823 there were only about 134,750 survivors. In 1872 the downgrade reached 56,897. Then plantations were opened up.

Speedy exploitation of Hawaiian agriculture (mainly pineapples) required thousands of laborers. The then small native population could not meet the demand, and an avalanche of immigration resulted. In 1930 the Islands boasted 368,336 people, mostly non-Hawaiian as shown by the chart that we reproduce herewith (Figure 7).

Young Chinese, Korean, Japanese and Filipino males swept into the gap. Most of the few European immigrants brought their families. More Japanese and some Chinese and Koreans imported wives later.

Of this population today 15,632 are Caucasian-Hawaiians, 12,592 Asiatic-Hawaiians, and it is estimated that 15.4 per cent are hybrids of one sort or another. "Of the total civilian population in 1930, 49.7 per cent were Mongolian; 17.7 per cent, Malay; 15.2 per cent Caucasian; 3.7 per cent Hawaiian and 13.7 per cent hybrid."

The Chinese, Portuguese and Japanese immigrants in turn worked on the plantations, saved their money, went into private business and migrated to the city of Honolulu especially. The unmarried Chinese came first to the plantations. About half of the 46,000 Chinese returned to China before 1900. Many of the remainder migrated to the cities, unburdened with families. The movement of the Portuguese was retarded, partly due to family shackles. The Japanese also migrated to the cities to a certain extent, but in the main they became small farmers. Many of them imported "picture brides" from Japan.

Color Bars

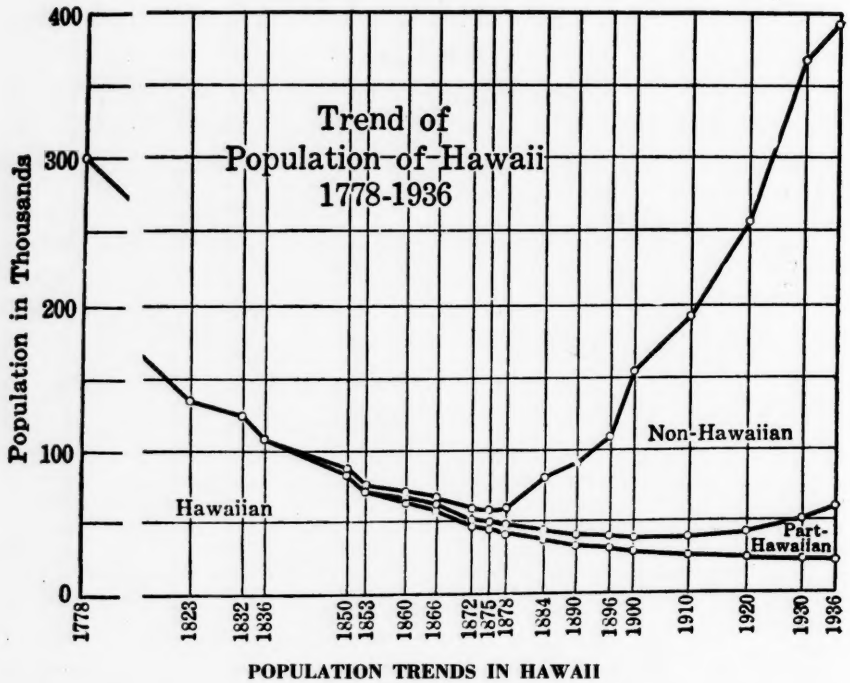
At many times and places in the history of mankind diverse races and cultures have collided and lived associated together for centuries in the same houses. Race taboos at once sprang up to protect the integrity of one race or another. Edward the Confessor placed a death penalty upon the marrying of an Irish wife. The Parsees strictly forbade marriages with the aborigines of India. Various continental European nations are striving violently today to prevent Semitic admixture of their seed stocks. The Asiatic Exclusion Act is one of our American versions of the color bar. The white-colored marriage laws of various States constitute another.

How did Hawaii escape race taboos?

The real flux in the pot is that public sentiment in Hawaii is not opposed to interracial marriage.

Personal and family sentiment may be opposed in certain social sets, but so counter to the mores of the islands are these views that those who hold them are discreet about public utterance. This sentiment favorable to race mixture is

*ADAMS, ROMANZO. Interracial Marriage in Hawaii. Pp. 353. $3.50. Macmillan, New York, 1937.



POPULATION TRENDS IN HAWAII

Figure 7

In 1778 Captain Cook estimated the population of the Islands at three hundred thousand. Half a century later it had declined to little more than a third of this amount. A century later the agricultural exploitation of the islands marked the beginning of a huge wave of migration to Hawaii.

remarkable in view of the race barriers that English speaking peoples have almost invariably set up in their exploitation of the world. The author attributes this phenomenon to the development of local mores in response to purely local conditions and to the fact that right of interracial marriage has been recognized in law. This unusual state of affairs probably grew out of the originally rather informal Hawaiian customs, which included only a very sketchy marriage ceremony, partners quitting each other at will, changing wives but not too frequently. Children were given away quite as a matter of course, and neither abortion nor infanticide met with public disapproval. A woman could have two husbands, a man more than one wife.

The Hawaiian melting pot began to bubble when King Kamehameha employed white men as advisers. These he gave chiefly rank, and provided them with wives of chiefly rank, as well as granting them permanently tracts of land. Since these first white men were revered as powerful nobles, it was no wonder that Hawaiian women of all social stations preferred them.

Ideas of racial behavior strengthened the interracial urge in Hawaiian women. As one Hawaiian woman expressed it: "The Hawaiian men are not steady workers and good providers. The Chinese men are good to provide, but they are stingy. The white men are good providers and they give their wives more money." Part-Hawaiians, including

some of Chinese ancestry, have come to enjoy an economic and social status superior to that of Hawaiians and all the larger estates now owned by descendants of old Hawaiian chiefs are in the hands of part-Hawaiians whose white paternal ancestors protected their inheritance. Such facts must of necessity influence the Hawaiian girls' preference.

It would be very interesting as a New Deal experiment, if suddenly on January 1st, 1942, many of the United States Senators, Congressmen, Governors and other State officials should take Japanese wives, crown them with wealth and place them in glittering society, with the President's active radio and press approval. In a generation the hybrids would control the wealth and industry of the country, in another generation interracial marriage of all sorts would be accelerated, color-lines would be abolished except among a few die-hard New England families, and in the third generation rarely could there be elected to office men of all white ancestry. What happened in Kamehameha's Island Paradise was almost as revolutionary.

Interracial marriage in Hawaii, as usual, flows mostly in one direction. Whereas part-Hawaiian males more frequently take part-Hawaiian brides, part-Hawaiian brides are most frequently married to non-Hawaiian grooms.

From 1866 to 1930 the ratio of part-Hawaiians to 1,000 Hawaiians rose from 57 to 1,079. In the same period the number of part-Hawaiians to 1,000 non-Hawaiians sank from 274 to 68.

The divorce rate in Hawaii appears not to be affected by interracial marriage; the mixed marriages appear to get on quite as well as the rest.

On account of the phobia expressed by some biologists against race mixing, the geneticist is particularly interested in what comes out of the crucible of the Pacific as viewed by Romanzo Adams. The answer is that no disharmonies are suggested, and that most of the differences noted between part-Hawaiians as compared with whites, Chinese and pure-Hawaiians are the results of cultural backgrounds. "Hybrid degeneracy" seems to be lacking, as far as these data disclose.

However, this is a sociological and not a genetic study: the chapters being devoted to a description of the swirls and eddies of migration, the nature of the ancestral stocks, and the social environments that are finally turning out a new mixed-race with a new mixed-culture thriving under a greater spirit of freedom and tolerance than we have record of in the history of mankind.

There seems to be nothing biologically wrong with this picture.

CLYDE E. KEELER

The Wistar Institute

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Racial Factors in the Hawaiian Labor Situation

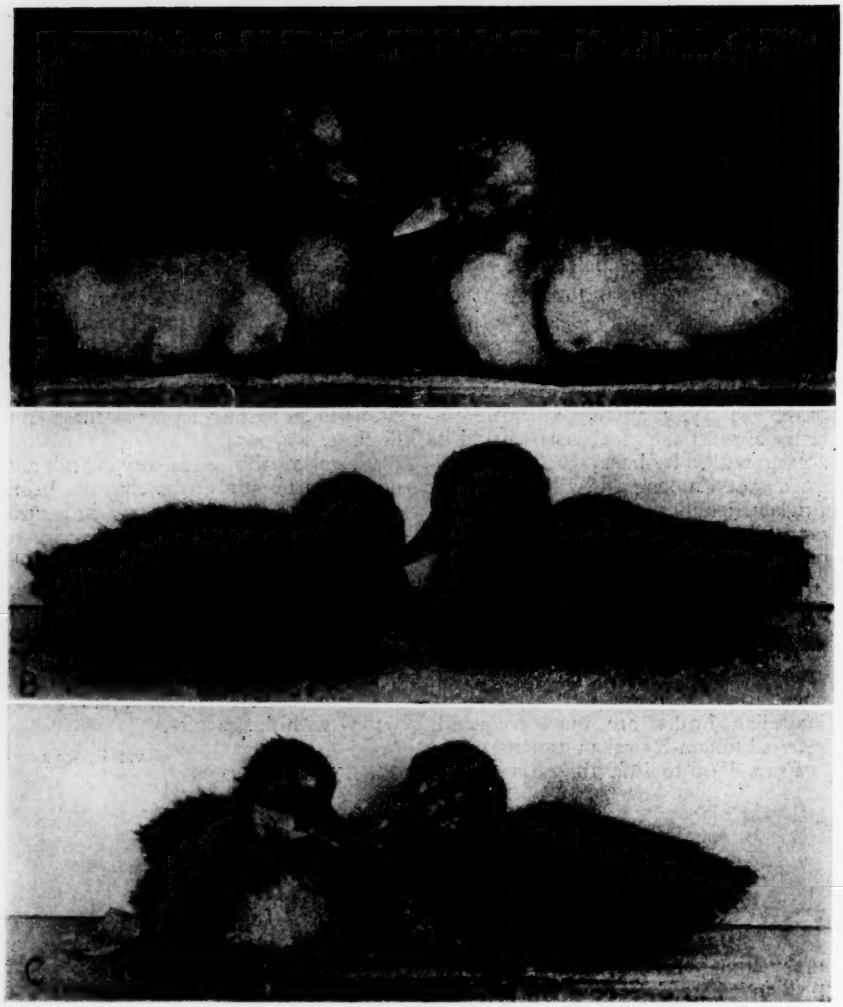
DR. KEELER'S review of Mr. Adams' book leaves no doubt that the melting pot bubbles faster in Hawaii than anywhere else in the United States, —perhaps faster than anywhere else in the world. It is therefore interesting that a recent survey of the labor situation in Hawaii conducted by the Bureau of Labor Statistics of the U. S. Department of Labor is able to identify definite labor practices which have a distinctly racial basis. "Marry them but don't hire them" would appear to be the situation.

This survey is summarized in the *Monthly Labor Review* for December 1940. The following excerpts have an especial interest in the light of Mr. Adams' findings with regard to race mixture in Hawaii:

* * * *

There was a fairly large importation of Portuguese between 1878 and 1900, and they now form over 7 per cent of the population. About this same time Japanese were imported, and rapidly assumed a major position in the population of the Islands. For the past 35 years they have held a position of numerical superiority, and now constitute over 37 per cent of the total population.

(*Continued on page 25*)



THREE DOWN PATTERNS

Figure 8

Three down patterns of mallard ducklings are shown: *A*—albinistic; *B*—melanistic; and *C*—normal. Small numbers of the light and dark variants appear each year in mass hatchings. Mating together of the light pattern produces normal.

UNUSUAL PLUMAGE OF DOMESTIC MALLARD DUCKS

E. A. McIlhenny
Avery Island, Louisiana

NOT often do we have an opportunity to observe consistent plumage differences in a normally pigmented race of birds in which both the plumage pattern and coloration is pronounced, and virtually identical in the species as a whole.

For more than twenty years I have been raising here at Avery Island, La., large numbers of Mallard ducks (*Anas platyrhynchos platyrhynchos*) using for breeding stock at first the ordinary game-farm raised birds purchased from a breeder in the north. The stock originally was of poor quality, but has been greatly improved by the use of males of wild stock. Now, the birds raised are practically identical in plumage with wild mallards.

For many years I have noted an occasional young duck completely golden white, not albino, and an occasional dusky-black individual. The plumage of these young birds was so unlike the normal coloration of young mallards, that, fearing if raised they would cause a deterioration in the breeding stock, I always had the white and the black young killed.

About eight years ago, I carried six young white ones to maturity. Four of these were females, two males. They were put in a separate yard, and in the spring produced a normal number of eggs. I hoped to establish by this mating a race of white mallards. To my surprise, the more than sixty young resulting from these matings were all normally colored mallards. The attempt to establish a white strain was abandoned, and all off-colored young thereafter were destroyed. Year by year these white and black ducklings appeared in each spring's hatch, without apparent reason.

During the hatch of 1939, and the hatch of 1940, a record was kept of these off-colored young ducks, and a number of them raised to maturity from the hatch of 1939. Except in color, they proved perfectly normal, and as hardy as their mates.

Not Albinos

The white birds are not true albinos, for, biologically speaking, an albino is a pigmentless individual of a normally pigmented race. An individual endowed by nature with an excess of pigment and darker plumage than the normal is termed melanistic. This correctly describes the darker phase described in this note.

Among mammals and birds, we have a number of instances of white variants which are not true albinos, for although the pelage or feathers may be completely white, exposed parts of the body including the eyes, may be normally-colored. In my wide experience in the Arctic and elsewhere, I have had ample opportunity to observe nature's adaptation of plumage and pelage to meet special climatic and environmental conditions.

The non-albinotic white pattern is widely distributed in the Arctic and in less rigorous climates. The Polar Bear (*Thalarctoc maritimus*) with its white fur, black eyes, black claws, black nose, and lips is the classic example of the Arctic white pelage. The Snowy Egret (*Egretta thula thula*) with its white feathers, black beak, and legs, black inside the mouth, and golden eyes is an instance of the same color pattern in a temperate zone species. This pattern is present in the juvenile form and is not altered throughout life.

A true albino, devoid of pigmentation even in the eye, may occur in either of these races, or in any other race. If the polar bear and the snowy egret were

albino, their pelage and plumage would be white and the beak, nose, eyes, and other exposed parts would be a light flesh color or pink—certainly not black. As they are at present, they represent white forms of their respective races, which breed true to their family color and characteristics.

A curious bond between the white pattern and a more extended pigmentation is to be found in some mammals and birds which change their fur or feathers to conform to the seasonal conditions under which they live. The fur of the White Fox (*Canis logapus*) is a blue-gray in summer, and its nose, claws and eyes are black. In winter, the pelage changes to snow white, but the nose, eyes and claws do not change color. This same color change in pelage occurs in the Snowshoe Hare (*Lepus aremicanus*) and the Ermine (*Putorisus rexosus eskimo*). In both the latter species the pelage is colored in summer and pure white in winter—a provision of nature to protect them in an environment which changes with the seasons, but the nose, mouth, claws and eyes of these animals remain black at all times. A clue to this situation may be furnished by the Siamese cat, in which the pattern has been shown to be due to the temperature at which the hair develops—hair developing below a critical temperature being more deeply pigmented the lower the temperature.

Both the fur of mammals and the feathers of birds make this seasonal change from dark to white, not by a change in developed feathers or fur but by a complete moult. This is especially noticeable in the Willow Ptarmigan (*Logopus albus* and subspecies).

Where great numbers of individuals of any species of birds or mammals are under observation, an occasional departure from the normal coloration may be observed. Such departures are so rare that they are very striking in a uniform population. Unfortunately, these variants are usually killed, so that it is impossible to determine the genetic basis for their unusual coloration. The vast majority of radical departures in plumage or pelage from the normal, lessens the efficiency and lowers the ability of the individual to cope with conditions surrounding it.

The adjustments of fur and feather coloration are set by heredity, and are due to specific pigments that absorb certain light vibrations and reflect others. The patterns of many wild species appear to be adaptive, to afford protection in relation to the background in which the creature lives.

The three accompanying photographs taken of the three types of juvenile plumage noted in newly-hatched Mallard Ducks from the hatch of June 8th, 1940, clearly illustrates: (1) Albinistic, (2) Melanistic, (3) Normal plumage, shortly after hatching (Figure 8).

These juvenile plumages develop into adult plumages as follows:

The light young, when adult, are pure white with yellow beak and feet and dark-brown eyes.

The dark young, when adult, are black to sooty-black, with sooty-black beaks, feet, and black eyes.

The partly-colored young develop the normal mallard plumage, without variation.

Using Ridgway's Nomenclature of Color as a guide, the coloration of these young ducks—a few days after hatching—is:

(1) LIGHT—Guard-hairs on back and sides . . . Empire Yellow. Down and underparts . . . Pale Chalcedony Yellow. Beak, feet, and toe-nails . . . Flesh Pink.

(2) DARK—Guard-hairs of back . . . Black. Down, all over body . . . Olivaceous black. Guard-hairs on breast and stomach . . . Dark Grayish olive . . . Feet, beak and eyes . . . Black.

(3) PARTLY COLORED (Normal)—A combination of the pattern and coloration of the first two—which combination is the normal one for Mallard ducklings.

The breeding stock which produced these young ducks has been most carefully selected for many years, and all off-color young have been eliminated; yet, these light and dark ducklings occur with considerable regularity.

Electric incubators are used in hatching the eggs, so an exact record of the young ducks and their variations is easily kept. A tabulation of the hatches for 1939 and 1940 follows:

Date 1939		*No. Hatched*	*Normal*	*Light*	*Dark*
April	11	507	504	1	2
April	18	356	353	1	2
April	24	410	406	2	2
May	1	296	294	1	1
May	8	461	457	2	2
May	15	430	427	1	2
May	22	425	419	2	2
May	29	392	390	1	1
June	5	691	686	2	3
June	12	670	664	3	3
June	19	653	648	2	3
June	26	755	750	3	2
July	3	653	648	2	3
July	10	148	146	1	1
Totals		6,847	6,794	24	29
Percentage			99.2	.35	.45

Date 1940		*No. Hatched*	*Normal*	*Light*	*Dark*
May	4	477	472	2	3
May	11	566	562	2	2
May	18	422	419	1	2
May	25	619	613	3	3
June	1	635	630	2	3
June	8	761	755	2	3
June	15	636	631	2	3
June	22	563	660	1	2
June	29	446	442	2	2
Totals		5,125	5,084	18	23
Percentage			99.2	.35	.45

Genetically this note poses problems but solves none. The fact that the light-colored birds when mated produced only normal offspring seems to be a paradox. Either the variations are non-genetic or they are not recessive, and yet a recessive inheritance would appear to be essential to explain the sporadic appearance of the aberrant forms. It is possible that two or more distinct recessive genes, producing the same phenotypic effect, are present in the population. Mating such different recessive individuals would give normal progeny. If the two white males had been of one type, and the four females of the other type, this would account for the observed results.

The consistent disparities in number of light and dark types is also interesting. Possibly the slight preponderance of duck ducklings is due to the fact that an occasional dark individual survives to maturity while all the light colored birds have been eliminated, thus slightly increasing the incidence of a recessive gene for the melanistic pattern.

Although it solves no problem this note does serve to call attention to the considerable number of genetic—or *possibly* genetic — differences brought to light in the mass breeding of birds which can be observed at refuges such as at Avery Island. Such bird refuges offer a unique opportunity to study genetics of wild species under much more favorable auspices than is usually possible.

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A Tailless Breed of Sheep

Development of the Notail sheep, J. W. Wilson (South Dakota Sta. Cir. 28 (1940), pp. 22, figs. 16).—Progress is described on the development of a strain of sheep with no tails or tails sufficiently short that docking was not required. The flock originated in 1913 by mating fat-rumped rams from Siberia with pure-bred and grade Shropshire, Cheviot, and Hampshire ewes. In 1926, 100 western cross-bred Rambouillet ewes were mated with 10 no-tail rams to improve the quality of the fleece. In the no-tail flock there was improvement in the elimination of the tail so that in 1939 most of the progeny had tails under 1.5 in. or no tails at all. None of the rams would eliminate the tails from the progeny of the first cross with other breeds and strains, but in the backcrosses only a very small proportion of the lambs needed docking.—*Experiment Station Record.*

STUDIES IN HUMAN INHERITANCE

XIX.—The Linkage Relations of the Blood Groups, the Blood Types, and Taste Deficiency to P. T. C.

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The Ohio State University

THE construction of maps of the human chromosomes is a desirable prerequisite to the further development of human and medical genetics. Certain difficulties lie in the way of such construction. Linkage studies in man require special technics, due to the fact that the coupling and repulsion phases are not readily distinguishable. Moreover, human families are small, the interval between generations is large, and test matings cannot be made at will.

In 1926 the senior author[9] presented the first method for studying autosomal linkage in man. It was a crude method in comparison to modern statistical technics, but through its use evidence was obtained for the independent transmission of the factors for the blood groups and eye color, the blood groups and recessive polydactylism, eye color and recessive polydactylism, and telangiectasis and the blood groups.[10-12]

Bernstein[1] and Wiener[15] independently devised improved methods of testing linkage in man. Certain refinements were added by Hogben[4] and by Fisher.[3] By the use of these methods it was shown that there is apparently independent transmission of the genes for the blood groups and the *M-N* types,[1, 16] the blood groups, major brachydactyly and taste deficiency to phenyl-thio-carbamide[5] and the blood groups, blood types, eye color and allergic disease.[17]

In 1935 Penrose proposed a method for determining linkage in man by the use of paired sibs, eliminating the necessity of data for two generations. This method is especially applicable when individuals are readily available in the form of sibships (for example, among college students), and in cases where both alleles for each character investigated are reasonably frequent. Using this method, Penrose demonstrated the independent transmission of the genes for the blood groups and eye color, and for red hair and eye color. Inconclusive evidence was found for the linkage of the factors for the blood groups and for red hair.

In 1937 Burks[2] presented the first clear-cut evidence of autosomal linkage in man. Using the paired-sib technic, which she had apparently independently devised and used (with negative results) as early as 1930, Burks studied a number of traits from the sixteen thousand family histories collected over a period of 25 years at the Eugenics Record Office. Among many characters tested with no resulting evidence for linkage, two pairs emerged for which the results were significantly positive. These were congenital absence of certain teeth and color of hair; and myopia and eye color. The crossover ratio for the first pair was estimated at .130 to .155. No estimate could immediately be made for the crossover value for the second pair of characters.

The present study involves the linkage relations of the genes for the blood groups, the blood types, and the taste deficiency to phenyl-thio-carbamide (P. T. C.). The data were obtained from families living in or near Columbus, Ohio. Sixty-four sibships, comprising 173 individuals, are included. These sibships furnish a total of 190 sib pairs.

The blood groups are considered as depending upon a series of three alleles,[9, 10] the blood types upon a pair of alleles with no dominance[7, 17, 6] and the reaction to P. T. C. upon a pair of alleles with dominance.[11, 12, 14]

The sib pairs were arranged in a series of two-by-two tables, according to the characters studied. Chi-square values

were calculated according to the formula:

$$\chi^2 = \frac{n(ad-bc)^2}{(a+b)\ (c+d)\ (a+c)\ (b+d)}$$

where a = total pairs alike in respect to both traits
b = total pairs alike in one but unlike in the other
c = total pairs alike in the other but unlike in the one
d = total pairs unlike in both traits
n = total number of pairs

The use of this method is not recommended where less than 100 sib pairs are used.

Table I gives the data for the individual sibs. Table II summarizes the chi-square and probability values of the two-by-two tables set up from these data. The two-by-two tables are on file in our laboratory and may be consulted by anyone interested.

TABLE I. Individual Sibs

Sib-ship	Sex	Taste P. T. C.	Blood Group	Blood Type
1	Male	Yes	A	M
	Male	Yes	A	M
	Male	No	O	M
	Male	Yes	O	MN
	Male	Yes	O	M
	Female	Yes	A	MN
	Female	Yes	A	M
	Female	No	O	MN
	Female	Yes	O	MN
2	Male	Yes	A	MN
	Male	No	A	MN
	Male	Yes	A	MN
	Male	Yes	A	MN
	Female	Yes	A	N
	Female	Yes	A	MN
3	Male	No	O	MN
	Male	Yes	O	MN
	Female	No	O	MN
	Female	Yes	O	MN
	Female	No	O	MN
	Female	No	O	M
4	Male	No	B	N
	Male	Yes	B	MN
	Female	Yes	B	MN
	Female	No	B	N
	Female	No	B	MN
5	Female	Yes	A	M
	Female	No	O	M
	Female	No	O	M
	Female	Yes	O	MN
	Female	Yes	O	M
6	Male	No	O	MN
	Male	No	B	MN
	Male	Yes	B	M
	Male	Yes	B	N
7	Male	Yes	A	MN
	Male	No	A	MN
	Male	Yes	O	MN
	Male	No	O	MN
8	Male	No	O	MN
	Male	No	O	M
	Female	No	O	M
9	Male	Yes	O	M
	Female	Yes	AB	M
	Female	Yes	B	M
10	Male	Yes	A	MN
	Male	Yes	A	MN
	Male	Yes	A	MN
11	Male	Yes	O	MN
	Male	No	O	MN
	Female	No	A	MN
12	Female	Yes	AB	N
	Female	Yes	A	MN
13	Male	Yes	AB	MN
	Male	Yes	A	MN
14	Male	No	B	MN
	Male	Yes	AB	MN
15	Male	No	A	M
	Male	Yes	A	MN
16	Female	Yes	AB	MN
	Female	Yes	A	MN
17	Male	Yes	A	M
	Male	Yes	A	M
18	Male	Yes	O	MN
	Male	Yes	A	N
19	Male	Yes	O	MN
	Male	No	A	N
20	Female	Yes	O	MN
	Male	Yes	B	N
21	Male	Yes	O	N
	Male	Yes	B	MN
22	Female	Yes	A	M
	Female	Yes	O	M
	Male	Yes	A	M
23	Male	Yes	O	MN
	Female	Yes	O	M
24	Male	Yes	O	MN
	Male	Yes	B	N
25	Male	No	B	N
	Male	No	O	M
26	Male	Yes	A	MN
	Female	No	A	MN
27	Male	No	O	MN
	Male	No	O	MN
28	Male	Yes	A	M
	Female	Yes	A	M
29	Male	Yes	O	M
	Male	Yes	O	M
	Male	Yes	O	M
	Male	Yes	O	M
	Male	Yes	O	M
30	Male	Yes	A	M
	Male	Yes	A	MN
31	Female	Yes	O	MN
	Male	Yes	O	N
32	Male	Yes	A	MN
	Male	Yes	A	MN
33	Male	Yes	A	MN
	Female	Yes	A	MN
34	Male	Yes	O	MN
	Male	Yes	O	N
35	Male	Yes	O	N
	Male	Yes	O	N
36	Male	No	A	M

A survey of Chi-square values and corresponding probabilities, with one degree of freedom, indicates that there is no significant evidence against the hypothesis that the observed deviations from proportionality should occur by chance alone.

There is only one of the chi-square values which approaches significance, that of the relationship of the agglutinogens *M* and *B*. Here it must be pointed out that in one entry in the two-by-two table for these characters, the expected frequency was less than five, which considerably impairs the accuracy of the probability value. It is also to be noted that the value for *M* and *A* (an allele of *B*) indicates free assortment.

The data therefore indicate the independent inheritance of the genes for the blood groups, the blood types and the reaction to P. T. C.

Literature Cited

1. Bernstein, F. *Zeitschr. f. ind. Abst. u. Vererb.* 57:113. 1931.

2. Burks, B. S. Yearbook, Carnegie Inst. of Wash., 36:312. 1937.

3. Fisher, R. A. *Ann. Eugenics* 6:187, 339. 1935.

4. Hogben, L. *Proc. Roy. Soc.* 114:340. 1934.

5. Hogben, L., and R. Pollack. *Jour. Genetics* 31:353. 1935.

6. Hyman, H. S. *Jour. Immunol.* 29:223. 1935.

7. Landsteiner, K., and P. Levine. *Jour. Exper. Med.* 48:731. 1928.

Sibship	Sex	Taste P. T. C.	Blood Group	Blood Type	Sibship	Sex	Taste P. T. C.	Blood Group	Blood Type
	Male	Yes	O	M	50	Male	No	A	MN
37	Female	Yes	A	N		Female	Yes	B	MN
	Female	Yes	A	N	51	Female	Yes	A	M
38	Male	Yes	A	M		Male	Yes	A	MN
	Male	Yes	A	M	52	Female	No	O	M
39	Female	No	A	N		Female	No	A	MN
	Female	Yes	B	N	53	Male	No	A	M
40	Male	Yes	O	N		Male	No	B	N
	Male	Yes	O	N	54	Male	No	O	M
	Male	Yes	O	N		Male	No	O	MN
41	Female	Yes	O	M	55	Male	Yes	O	N
	Male	Yes	O	M		Male	Yes	O	N
42	Male	Yes	O	M	56	Female	Yes	A	N
	Male	Yes	O	M		Male	Yes	A	N
43	Female	Yes	A	N	57	Female	Yes	O	M
	Female	Yes	O	MN		Female	Yes	AB	MN
44	Male	Yes	A	N	58	Male	No	AB	MN
	Male	Yes	A	MN		Male	Yes	B	M
45	Male	No	O	MN		Male	Yes	B	N
	Female	Yes	B	M	59	Male	Yes	O	MN
	Male	Yes	O	MN		Male	Yes	O	M
	Male	Yes	B	M	60	Male	Yes	A	MN
	Female	No	O	M		Male	Yes	A	MN
46	Male	Yes	O	M	61	Male	Yes	O	MN
	Male	Yes	O	N		Female	Yes	O	M
47	Male	Yes	A	MN	62	Male	Yes	A	M
	Male	Yes	A	M		Male	Yes	A	M
48	Male	Yes	A	N	63	Male	Yes	B	MN
	Male	Yes	B	N		Male	Yes	A	MN
49	Female	Yes	B	M	64	Female	Yes	O	N
	Male	No	AB	M		Female	Yes	A	M

TABLE II. Summary of Chi-Square and Probability Values

	Agglutinogen *A*	Agglutinogen *B*	Agglutinogen *M*	Agglutinogen *N*
P. T. C.	$\chi^2 = 0.7904$ P = .50-.30	$\chi^2 = 0.0094$ P = .95-.50	$\chi^2 = 0.6476$ P = .50-.30	$\chi^2 = 0.6907$ P = .50-.30
Agglutinogen *A*			$\chi^2 = 1,2418$ P = .30-.20	$\chi^2 = 0.4541$ P = .95-.50
Agglutinogen *B*			$\chi^2 = 3.5777$ P = .10-.05	$\chi^2 = 0.0615$ P = .95-.50

8. PENROSE, L. *Ann. Eugenics* 6:133. 1935.
9. SNYDER, L. M. *Zeitschr. F. Immunitstsf. u. exper. Ther.* 49:464. 1926.
10. ————————. Blood Grouping in Relation to Clinical and Legal Medicine. Baltimore, 1929.
11. ————————. *Science* 74:151. 1931.
12. ————————. *Eugenical News* 16: 117. 1931.
13. ————————. *Ohio Jour. Sci.* 436. 1932.
14. ————————. *Genetics* 19:1. 1934.
15. WIENER, A. S. *Genetics* 17:335. 1932.
16. WIENER, A. S., and M. VAISBERG. *Jour. Immunol.* 20:371. 1931.
17. ZIEVE, I., A. S. WIENER, and J. H. FRIES. *Ann. Eugenics* 7:163. 1936.

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Racial Factors in the Hawaiian Labor Situation

(*Continued from page* 17)

Japan as a labor market was largely cut off by the "Gentleman's Agreement" of 1908, so the plantations turned to the Filipinos who were imported in slowly increasing numbers until 1920. Because of the strikes of Japanese plantation workers in 1920 and the Exclusion Act of 1924, which entirely prohibited the Japanese from entering the United States (including the Territory), the plantations imported Filipinos in much larger numbers during the twenties. But whereas the Japanese had brought "picture brides" in large numbers, the Filipinos came as single men. Many of them returned to the Philippines in the thirties, so that there has been a net decline in the number of Filipinos in recent years.

In 1935, when the Philippines became a commonwealth, immigration of Filipinos into Hawaii and the mainland was limited to 50 a year, and when the commonwealth becomes a free republic in 1946, the annual maximum will be 100.

Caucasians, who were among the earliest migrants, show a slow, continuous growth in numbers throughout the whole of the modern period, but they constitute only 26 per cent of the total population. If the Portuguese, Puerto Ricans, and Spaniards (who are largely plantation or industrial workers) are not counted, the remaining Caucasians number only 16 per cent of the total population. This latter group (primarily Americans from the mainland) holds the financial control and management of the greater part of the island industries.

(3) Since 1930 there has been a tendency toward population stabilization, accompanied by an effort toward economic stabilization. Today, because of immigration restriction, the American mainland constitutes the only significant source of migrants to the Territory.

* * * *

Economic Stratification by Race

Also to be noted is the tendency toward economic stratification by race. There is a well-known comment on wages in Hawaii that "There are three levels of wages in the Territory: (1) What the 'haole' [Caucasian] pays the 'haole', (2) what the 'haole' pays the oriental, and (3) what the oriental pays the oriental."* Studies of the wage structures of various Hawaiian industries indicate that there are a number of large industries in which this statement does not apply. In such firms, variations in earnings by race are so slight as to be of no significance. In many, given rates are paid for specific types of work regardless of race. In the public utilities, for example, it was shown that the average annual earnings of Chinese workers were somewhat above those of the Caucasians, although the public utilities are under Caucasian management.

Nevertheless, there is some justification for the commonly accepted belief quoted above. In the printing and publishing industry, for example, variations in earnings by race are very marked. Japanese employed in this industry received half as much in hourly earnings as Caucasians. In the construction industry, conditions are such that practically all of the private construction is in the hands of Japanese contractors, who employ Japanese workers. Fifty-two per cent of the workers in private construction received less than 45 cents per hour, whereas all workers in public construction received over 45 cents per hour. Among the unskilled laborers in this field, the highest paid workers in private construction received less than the lowest paid workers in public construction.

Relative position of racial groups. — The Caucasians who migrated to Hawaii from the American mainland hold the dominant economic position in terms of both wealth and management. Broadly speaking, Hawaiians and Portuguese are next. The economic strength of the Hawaiians grows out of their historic position in the Islands, which has in some cases made possible the retention of large blocks of land. The rapid diminution in the number of Hawaiians† meant that, insofar as

(*Continued on page* 36)

*The term "haole" means a person with white skin, hence a foreigner, and is commonly used to designate Caucasians of better-than-average social and economic position.

†It should be noted, however, that the downward trend in the number of native Hawaiians was checked about the beginning of the century. Both Hawaiians and part-Hawaiians are now on the increase.

FRATERNAL AND IDENTICAL TRIPLETS

Figure 9

Set 1 (Martha, Joseph and Mary) consists of a pair of identical twins and a brother. Set 2 (Maxine, Claudine and Charlene) are identical sisters, alike in all the categories studied. They are all above average in I. Q., in spite of an environment offering few advantages.

THE DIAGNOSIS OF FIVE SETS OF TRIPLETS

IVA COX GARDNER AND D. C. RIFE
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FIVE sets of triplets attended the recent Baylor University Twin Convention, and presented interesting subjects for various scientific tests. Of the five sets, one is monozygotic, two are dizygotic and two are trizygotic. Sets one and five are dizygotic. Set one is made up of a set of identical girls and a boy fraternal to the girls. Set five consists of a set of identical boys and a girl fraternal to the identical boys. Sets three and four are trizygotic. Set three is made up of two boys and one girl, quite unlike. The members of set four are all boys and no two are alike. The members of set two are all girls and as much alike as the proverbial peas in a pod. The relative efficiencies of blood tests, dermatoglyphics and pigmentation of eyes as criteria of zygosity were well demonstrated in tests of the triplets.

Table I shows the palm and finger formulae, the blood groups and the *M* and *N* reactions, the pigmentation, and the sex of all fifteen individuals. Figures 9 and 11 show photographs of four of the five sets, which are in themselves rather conclusive evidence of the zygosity of each set.

Any sets consisting of both males and females cannot be monozygotic. In Set 1, Mary and Martha must be fraternal twins of Joseph. In Set 3, Bettie must be a fraternal twin of Bobbie and Billie, and in Set 5, Florine must be a fraternal twin of Fred and Frank.

Any intra-pair difference in either the blood groups or the *M* and *N* reaction are conclusive evidence of dizygosity. In Set 4, no two are alike in both the above respects, thus demonstrating them to be trizygotic. Interestingly enough, difference in the blood reactions confirm the dizygosity demonstrated by differences in sex in Sets 1, 3 and 5.

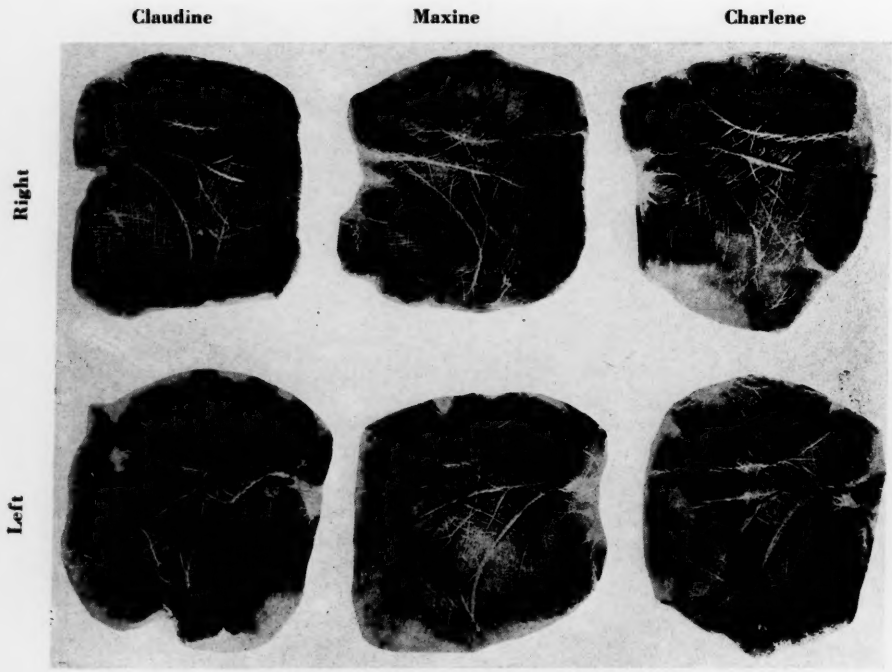
In Set 3, Billie and Bobbie show marked differences in iris pigmentation and some difference in hair color, demonstrating them to be dizygotic, and thus the whole set to be trizygotic.

In Set 1, we find Joseph has lighter eyes than his sisters, who show no intra-pair differences in pigmentation. Also, in Set 5, we find Florine has darker eyes than Fred and Frank, who show no intra-pair differences. In Set 2, we find all three members to be alike in blood group and the *M* and *N* reaction, sex and pigmentation. While differences in any of the above traits are conclusive evidence of dizygosity, fraternal twins may be alike in any or all of them. Sex and the blood tests are completely objective in nature, and 80% of fraternal twins show some sort of intra-pair variation. Pigmentation of the iris and its distribution is of a more subjective nature, efficiency of its analysis depending to some extent on the tester and on the lighting conditions under which the eyes are examined. Under optimum conditions, we should expect no more than one in twenty pairs of fraternal twins to be as similar as monozygotic twins.

Unfortunately, the eye pigmentation of the triplets was examined under very unfavorable conditions, and the odds are more likely of the order of one in five that dizygotic twins would be alike in iris pigmentation.

Evidence of the Palm Prints

The finger and palmer dermatoglyphics are of especial value in that they not only furnish supplementary evidence of dizygosity and trizygosity, but also give positive evidences of monozygosity for Set 2, and for Mary and Martha in Set 1, and Fred and Frank in Set 5. Note in Set 2, that the main lines of all three left hands have the same formulations, as do the finger pattern distributions of the



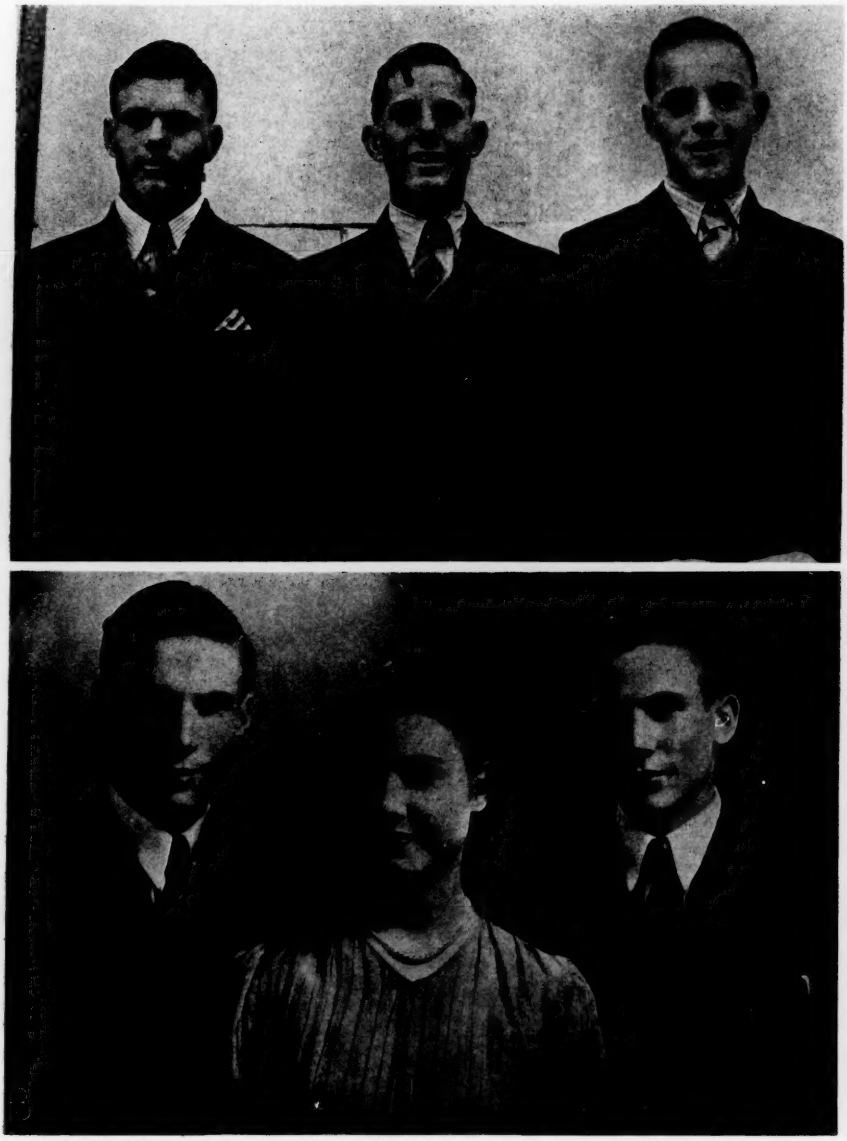
PALM PRINTS OF CLAUDINE, MAXINE AND CHARLENE

Figure 10

The striking similarities in palm print patterns confirms the conclusion that these three girls are identical. There are very rare reversals in these patterns as compared with the generality of palm prints that make this evidence especially convincing.

three right hands. Even more striking is the presence of thenar patterns in all six palms. Thenar patterns occur in less than ten per cent of the palms of North American whites, and about twice as frequently in left hands as in right hands. Yet in Set 2, the greatest thenar pattern intensity is found in the right hand of Charlene, whereas the left hand of Maxine possesses the smallest thenar pattern. Also, the main line formulae show more transverse ridges in the left than in the right palms, just the reverse of the trend in the general population. The presence of these unusual characteristics and the great homolaterial similarities of the palms of all three individuals are unusually strong evidences of monozygosity. As demonstrated in Figure 10, they are tremendously alike in features and general appearance, so much so that people cannot tell them apart. That Set 2 is monozygotic, is demonstrated beyond any reasonable doubt.

In Set 1, we find the similarities in the dermatoglyphics of both Mary and Martha are strikingly superior in line counts to those of Joseph. There are notable homolateral similarities in the palms of the two girls, especially the *D* pattern in left fourth inter-digital area of the left palms. Of especial interest is the presence of a thenar pattern in the right palm of Mary and in the left palm of Martha. This is the first case of such heterolateral similarity in thenar patterns we have observed in the formulation of the palms of 175 pairs of monozygotic twins. Mary and Martha are also extremely similar in general appearance and we feel the evi-



SETS FOUR AND FIVE

Figure 11

Morris, Marshall and Marvin are so unlike in physical appearance as to cause no confusion in identification. Marshall and Marvin differ in hair color and in blood group as well as in other characteristics. In Set 5 (lower) Frank and Fred are identical twins of Florine.

dence that they are monozygotic is quite convincing.

The dermatoglyphics of Frank and Fred, in Set 5, while showing greater homolateral than bilateral or heterolateral similarities, possess no outstanding features, such as were present in Sets 1 and 2. Furthermore, the prints of Florine are remarkably similar to those of her brothers. Even so, MacArthur has shown that only about one pair of dizygotic twins in six show greater homolateral than bilateral or heterolateral similarities. Thus, their dermatoglyphics give confirmatory evidence of monozygosity, although not as striking as for Cases 2 and for Mary and Martha of Case 1. Fred and Frank are both of blood group *B*. and show *N* antigen reaction, whereas Florine is *O* and *M N*. The odds are at least four to one against their being similar in blood reactions, if dizygotic. Both are unusually tall, and as shown in Figure 11, have strikingly similar features. We have no hesitation in diagnosing Fred and Frank as monozygotic.

In Set 4, the finger patterns alone of Morris are sufficiently different from those of either of his brothers to show definitely that he is of another genotype. The palm prints of Marvin are sufficiently different from those of either Morris or Marshall strongly to indicate independent zygotic origin. In Set 3, we find considerable variation in the dermatoglyphics of all three individuals, confirming the diagnosis of trizygosity.

Thus these five sets of triplets presented no unusual difficulties in diagnosis of zygosity, the various tests confirming the judgment of most casual observers.

All members of Sets 1 and 5 are right handed. In Set 4, Marvin is left handed and his brothers right handed. Sets 2 and 3 were too young for the accurate determination of handedness.

Histories of the Triplets

Set 1. Mary, Martha and Joseph, were born March 30, 1930, in Waco, Texas, and have lived in Waco all their lives. There are eight children in the family including the triplets who are the youngest. The father is almost totally blind. He receives a small pension from the government. The mother is a very energetic woman and in spite of adverse circumstances has fed and clothed her family very well. The triplets were six and one-half years of age when they entered school. They have lost only a half a grade in school so far. They are ready to enter the fourth grade when school opens this fall.

On the Stanford-Binet Test:

	I.Q.
Mary	98
Martha	82
Joseph	90

There is more difference found in Mary and Martha's score than in Martha and Joseph's but all fall within the same group of low normal. Mary appears to be the leader of the group and Joseph more submissive than either of the girls. The grades in school of the triplets follow the same rank order as their psychological tests indicate.

Set 5, the other dizygotic set, Frank, Fred and Florine, were born in Hafkins, Texas, and are now sixteen years of age. The psychological test and grades of this set of triplets was secured from the superintendent of the High School which they had attended.

This set of dizygotic triplets differ from Set 1 in that the fraternal twin, Florine, seems to lead rather than follow the identical boys. The Superintendent of their High School reports that Florine has never failed in a course in High School, while both Frank and Fred failed Plane Geometry at the same time. Fred failed Spanish one year and Frank failed the second year of Spanish. There is very little difference in the grades of the triplets but the rank order is the same as their Psychological tests indicate.

Henmon-Nelson Test given at the Mineola High School:

	I.Q.
Florine	84
Frank	83
Fred	79

The intra-difference is small in this set of triplets in both grades and psychological tests.

Set three, Billie, Bobby and Bettie, are

trizygotic. They are so unlike in appearance that it would be hardly possible to confuse them. They were born April 15, 1936. Bobbie is the largest of the three, Billie next and Bettie the smallest as you would expect since she is the girl in the group. They are the youngest in a family of five including the triplets. Bobby is noticeably the leader and the quicker of the group while Bettie is the slowest and seems to initiate very few reactions. While Bobbie responded very well to the test he was very much afraid of the camera. The photographs proved worthless and none is included.

The Stanford-Binet Test was given the Triplets:

	I.Q.
Bobbie	100
Billie	93
Bettie	85

There seems to be a greater difference between the triplets of this group than in any other group.

Set 4, Morris, Marvin and Marshall, were born February 29, 1924, on a farm about three miles from Hillsboro, Texas. This set of triplets is of the same sex but they are so unlike in physical appearance as to cause no confusion in identification. This is the only set of triplets that we have so far been unable to secure psychological tests on. Several visits have been made to the home, but we were unable to arrange a time for the tests. This summer they are in the harvest field and are away from home and so we shall have to secure these later. The boys are somewhat retarded for their age in school. They are in the eighth grade. The mother reports their progress about the same. They work well on the farm and seem quite dependable.

Set 2, Maxine, Claudine, Charlene, the monozygotic triplets in this group were born near Mt. Calm, Texas, December 18, 1936. The order of birth was as given above. They are the youngest of six children, all girls including the triplets. The father is a tenant farmer and has been all his life. They are very poor and educational opportunities are of the meagerest kind. The other sisters in the family are nine, eight and five years, respectively.

Results for the Stanford-Binet Test:

	I.Q.
Maxine	115
Claudine	117
Charlene	113

Case No.	Name		Palm Formulae	Finger Patterns	Sex	Blood Group	M&N	Eye Color
1	Mary	R. 9.7.5'.3.	- t -L^{r}.L.0.0.L.	L^{u}.A.L^{u}.L^{u}.L^{u}.	♀	O	N	Brown
		L. 7-9.9.5.3.	- t -A^{u}.0.0.L.D.	W.W.L^{u}.W.L^{u}.				
	Martha	R. 9.X.5'.3h	- t -L^{r}.0.0.0.0.	L^{u}.A.L^{u}.W.L^{u}.	♀	O	B	Brown
		L. 9.X.5'.3	- t -A^{u}.L.0.0.D.	W.L.L^{u}.W.W.				
	Joseph	R. 11.9.7.5'	-t" -L^{c}.0.0.L.0.	L^{u}.W.L^{u}.L^{u}.L^{u}.	♂	O	MN	Gray green
		L. 11.X.7.1	-t" -L^{c}.0.0.0.0.	L^{u}.W.L^{u}.W.W.				
2	Claudine	R. 9.9.5".3	- t -A^{u}.L.0.L.D.	L^{u}.W.L^{u}.W.L^{u}.	♀	O	MN	Light blue
		L. 11.9.7.3.	- t -A^{u}.L.0.L.0.	L^{u}.L^{u}.L^{u}.W.L^{u}.				
	Maxine	R. 10.7.6.5'.	- t -A^{u}.L.0.0.L.	L^{u}.W.L^{u}.W.L^{u}.	♀	O	MN	Light blue
		L. 11.9.7.3	- t' -A^{u}/A^{c}.1.0.L.V.	L^{u}.W.W.W.L^{u}.				
	Charlene	R. 9.7.5".5'.	-tt' -L^{u}.L/L.0.0.L.	L^{u}.W.L^{u}.W.L^{u}.	♀	O	MN	Light blue
		L. 11.9.7.3.	- t -A^{u}.L.0.L.0.	L^{u}.W.W.W.L^{u}.				
3	Bobbie	R. 9.7.5".3.	- t -A^{u}.0.0.0.L.	L^{u}.L^{u}.A.L^{r}.L^{u}.	♂	A	MN	Blue
		L. 11(10).7.7.3	- t -A^{u}.0.0.0.L.	W.A.A.A.L^{u}.				
	Billie	R. 7.5".5'.3.	- t -L^{r}.0.0.0.L.	L^{u}.A.L^{u}.L^{u}.L^{u}.	♂	A	MN	Brown
		L. 5".5'.4.3.	- t -L^{r}.0.0.0.0.	L^{u}.L^{u}.A.L^{u}.L^{u}.				
	Bettie	R. 9.7.5".3	- t -A^{u}.0.0.0.L/D.	L^{u}.L^{u}.L^{u}.L^{u}.L^{u}.	♂	O	MN	Brown
		L. 11.7.7.3	- t -A^{u}.0.0.0.L.	L^{u}.A.A.L.W.				
4	Marshall	R. 11.9.7.5'.	- t -A^{u}.0.0.L.0.	L^{u}.L^{u}.L^{u}.L^{u}.L^{u}.	♂	A	M	Blue
		L. 9.9.5".3	- t -A^{u}.0.0.1.V.	L^{u}.L^{u}.L^{u}.L^{u}.L^{u}.				
	Marvin	R. 11.9.7.3h	- t -L^{r}.0.0.1.0.	L^{u}.L^{r}.L^{u}.L^{u}.L^{u}.	♂	O	M	Blue
		L. 9.0.5'.3h	- t -L^{r}.0.0.0.0.	L^{u}.L^{r}.L^{u}.L^{u}.L^{u}.				
	Morris	R. 11.9.7.5'	- t -A^{u}.0.0.L.0.	W.W.W.W.L^{u}.	♂	A	MN	Blue
		L. 11.9.7.4	- t -A^{u}.0.0.L.0.	W.W.L^{u}.L^{u}.L^{u}.				
5	Fred	R. 11.9.7.5'.	- t' -L^{r}.0.0.L.0.	W.W.W.W.L^{u}.	♂	B	N	Light blue
		L. 11.9.7.6'.	- t -V.0.0.L.0.	L^{u}.L^{u}.W.W.W.				
	Frank	R. 11.9.7.5'.	- t' -A^{u}.0.0.L.0.	W.W.L^{u}.W.W.	♂	B	N	Light blue
		L. 9.9.5".5'.	- t' -A^{u}/A^{c}.0.0.1.0.	L^{u}.L^{u}.W.W.W.				
	Florine	R. 11.9.7.5'.	- t' -A^{u}/A^{c}.0.0.L.0.	L^{u}.W.L^{u}.W.W.	♂	O	MN	Dark blue
		L. 11.9.7.5'.	- t' -A^{u}/A^{c}.0.0.L.0.	L^{u}.W.L^{u}.W.W.				

There is little difference in the Triplet's I.Q. and they made an excellent showing on the test considering their very meager opportunities. The mother appears to have considerable ability but her opportunities seem never to have been much better than those now available for the children.

This is the beginning of a psychological study on all the triplets, which it is proposed to continue during their development.

Summary

The monozygotic set of triplets as one would expect are most alike physically and mentally of any of the sets. They are not old enough to go to school and live a very isolated life in the country.

In the two dizygotic sets the fraternal one leads in the group in one set while in the other set, one of the identical twins is definitely the leader and the fraternal twin follows the pace set by the identicals.

The two trizygotic sets are of course most unlike physically and possibly mentally also. Set 3 is not yet in school, but shows a greater difference in psychological scores than anv of the others.

On the study of the educational careers of the triplets up to date there appears a mutual helpfulness on the part of the members of the sets. Twinness and tripleness as such seems to play a greater part in development than has been realized up to date. But this impression awaits further study.

✦

Genetics on "Information Please"

IN recent weeks attention has been called to two very interesting questions on the "Information Please" program. Both these have stumped the experts and have quite rightly earned those who submitted them a set of the *Encyclopedia Britannica.* Possibly readers of the JOURNAL who feel the need for cosmic quantities of information can cash in on the experts' genetic weaknesses to gain this coveted prize of 24 volumes of authoritative information on practically everything.

The first question which stumped the experts, and which aroused very violent objections from Expert Kieran was this: "What animal has a mother but no father?" Mr. Kieran was considerably upset by such a possibility and allowed it was agin' nature,—that the birds and the beasts didn't do things that way. The rest of the experts did not know, but they took their ignorance considerably more quietly than Mr. Kieran. There might have been several answers to the question, as parthenogenesis is not an unusual phenomenon in the world of life. The answer: "a drone bee," was hotly contested by Mr. Kieran who denied this possibility vehemently. The following week he blushingly recanted.

The second genetic puzzler to leave the experts silent deserves a couple of sets of the *Encyclopedia Britannica:* "What animal is it that if all of them were dead, could none the less be reproduced at will and with the greatest of ease?" Mr. Kieran immediately wanted to know whether it was that drone bee again. This Mr. Fadiman denied. One of the experts tried to make a case for chickens. He argued that if all the chickens in the world were exterminated it would be possible to hatch a batch of eggs which had providently been laid before the barnyard catastrophe had wiped out the poultry population of the world. Mr. Fadiman was on solid biological ground in holding a chick in the egg was alive and that the definition required that all eggs be broken too. It was not surprising that the experts were stumped. The answer was a very interesting one,—the mule.

Are there other genetic problems equally perplexing for the experts?

INHERITANCE OF SHELL FINISH IN SINGLE COMB WHITE LEGHORNS*

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University of California, Berkeley

THE purpose of this report is to place on record some data on the hereditary nature of the type of shell finish of eggs laid by Single Comb White Leghorns. The breeding lines which provided the birds for the study of this problem originated from four Pacific Coast strains crossed with the University of California flock several generations prior to the beginning of this experiment. Observations were made in the course of five years on the offspring of matings of birds selected for type of shell finish. While this work has been now discontinued in favor of more pressing problems, the results obtained are deemed worthy of publication, since no comparable observations can be found in the literature.†

The experiment was started by the senior author in consequence of his observation that in crosses between Silver Spangled Hamburgs and Black Minorcas, the eggs laid by the first filial generation of pullets exhibited a glossy finish characteristic of the Hamburg parents. The Minorca parents, on the other hand, laid eggs most aptly described as chalky in finish. The backcrosses to the Minorca dams produced 11 pullets laying chalky eggs and 9 laying glossy eggs. This observation led to the idea that the glossy character of the eggs was dominant to the chalky finish. As will be shown later the reverse is true within the Leghorn breed.

Since in the Single Comb White Leghorn flock of the University of California both individuals laying glossy eggs and those laying chalky eggs were discovered, several matings were made including both types. These matings, involving a total of three males and 24 females of the original foundation stock, and ten males and 63 females produced from the foundation stock or their offspring, were continued for five years. Considering only those pullets which laid 50 or more eggs in the first 365 days of production, a total of 503 pullet offspring was obtained. These together with the 24 foundation stock females comprise the 527 females on which this report is based.

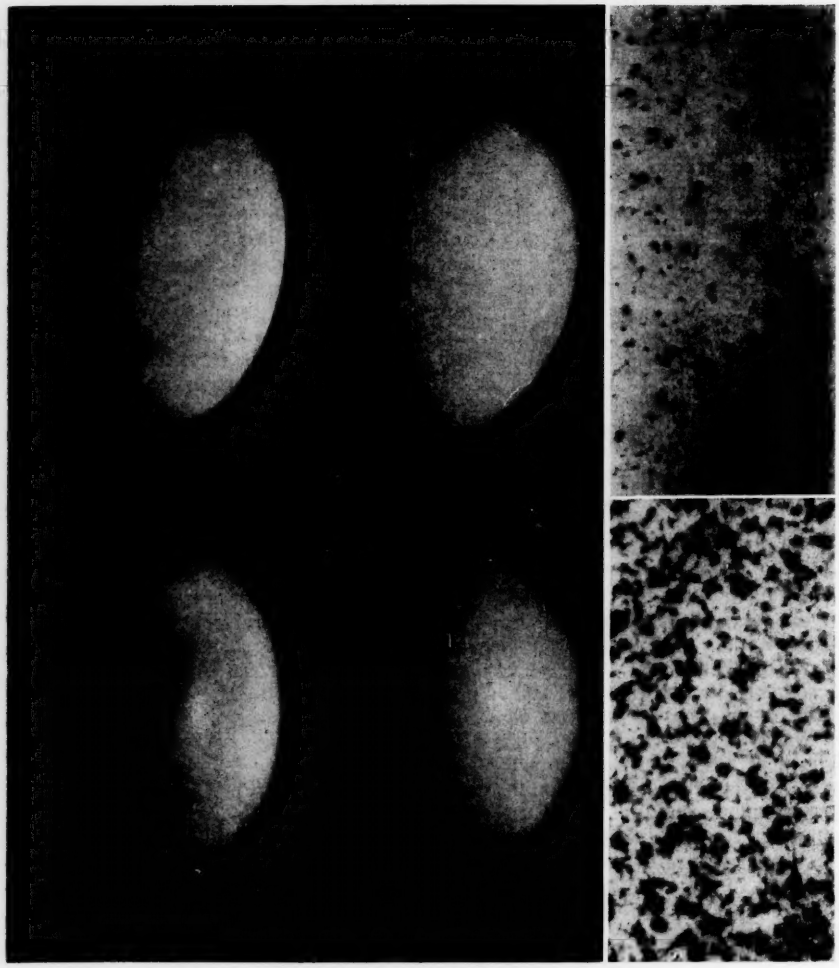
The difference between chalky and glossy finish is illustrated in Figure 12 which shows the appearance of the eggs under a strong light. All of the eggs were classified on basis of the difference in light reflection as seen in this figure. This figure also presents photomicrographs of typical areas of chalky and glossy shells after staining with a supersaturated aqueous solution of potassium permanganate.‡ The difference in type of shell finish is probably related to both the relative amount and distribution of cuticle or bloom found on the surface of the egg shell. Potassium permanganate stains only the bloom on the shell and demonstrates clearly the difference between chalky and glossy finishes.

The finish of all eggs laid by the birds included in this report in course of their first year of production was recorded as observed directly under 150 watt lamps. The only exception was one of the foundation stock females who was in her third year of laying when the experiment was started. In her case the observations on the third year production (155 eggs, all chalky) were considered equivalent to those made in the first year of

*Assistanace in recording observations and in tabulation was provided under auspices of WPA Official Project 65-1-08-91-B6.

†WALTHER (1914, *Landw. Jahrb.* 46:89) described the shells of eggs laid by a few individuals of several breeds as being glossy, slightly glossy or dull in finish.

‡This method was suggested by Dr. H. J. Almquist.



GLOSSY AND CHALKY EGGS

Figure 12

Appearance of (*A*) chalky and (*B*) glossy eggs under bright light. Note the high lights on the glossy eggs. Photomicrographs (10×) of areas of shell after staining with potassium permanganate. This stains only the cuticle or bloom, and shows how the eggs differ in the distribution of this element.

the other birds. This is a justifiable assumption since it has been observed that all the shell finish of eggs laid by a female throughout her life generally is adequately measured by one year's production.

The percentage of glossy eggs by each bird during the year was calculated. Figure 13 shows the frequency distribution of this value for the 527 birds. The distinct bimodality of the curve suggests a comparatively simple mode of inheritance of shell finish. The four birds in the 50.1-60.0 per cent array had the values 51.4, 53.8, 57.7, and 58.0. For the sake of simplification non-overlapping ranges of 00-50.0 per cent for the chalky phenotype and 50.1-100.0 for the glossy type were adopted. All birds were accordingly classified as either "chalky" or "glossy."

On a basis of (1) ancestry, (2) the bird's own performance, and (3) progeny where available, all the birds were assigned presumptive genotypes. A tabulation by matings revealed that chalky finish behaved as a single factor dominant. This factor is designated *Ch*, and Table I presents the observed ratios together with deviations from expectancy on this basis. It may be noted that reasonably good fits were obtained in all cases.

It would, however, be rash to assume that a one factor difference will account

Table I - Ratios Observed in Matings of Different Types.

Parental Genotype		Observed Ratio		Deviation from expected ratio
Sire	Dam	Chalky	Glossy	
ChCh	ChCh	7	0	0
ChCh	Chch	12	0	0
ChCh	chch	6	0	0
Chch	Chch	30	0	0
Chch	Chch	75	35	7.5±4.5
Chch	chch	82	102	10.0±6.8
chch	Chch	23	0	0
chch	Chch	41	32	4.5±4.1
chch	chch	0	58	0
Total expected 1:0		78	0	0
" " 3:1		75	35	7.5±4.5
" " 1:1		123	134	5.5±8.0
" " 0:1		0	58	0

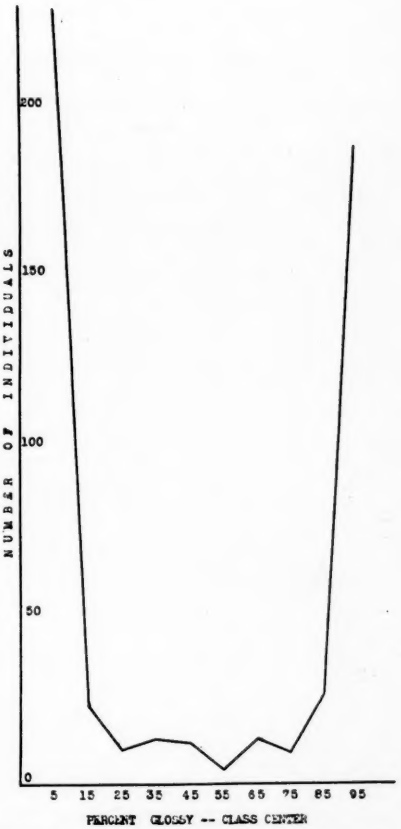
Table II - Constants for Groups of Assigned Genotypes.

Genotype	Number	Mean percent glossy	Standard deviation	Range
ChCh	15	1.93	2.59	0.0-7.3
ChCh or Chch (undetermined)	115	5.85	9.38	0.0-43.5
Chch	157	9.01	13.36	0.0-49.5
chch	240	93.25	10.39	51.4-100.0

Difference between ChCh and Chch 7.08±1.26

Table III. Mean Percent Glossy Eggs Laid by Daughters in Relation of the Phenotype of the Dam.

Mating	Phenotype of dam	Daughters			
		Chalky		Glossy	
		Number	Mean % glossy	Number	Mean % glossy
chch♂ x Chch♀	0.0 - 10.0%	8	1.96	14	96.59
	10.1 - 20.0	3	3.27	1	100.0
	30.1 - 40.0			2	70.75
Chch♂ x chch♀	50.1 - 70.0	4	13.05	5	86.26
	80.1 - 90.0	9	18.08	7	87.54
	90.1 -100.0	22	14.69	16	98.40



CHALKY AND GLOSSY DISTRIBUTION
Figure 13

Frequency distribution of 527 birds with respect to the percentage of glossy eggs laid in the first year of production. The peak to the left represents the chalky group: that to the right the glossy group.

for all of the information available. The assumption that the differential of one gene accounts equally for the difference between 49.5 and 51.4 per cent (extreme ranges of chalky and glossy phenotypes) and for the difference between 0.0 and 100.0 is a tenuous one. As is shown in Table II the expression of dominance is not complete, but it is not possible to distinguish heterozygous from homozygous chalky individuals.

If, in the material available, birds with different degrees of expression of the chalky or glossy character were mated to a single male, the percentages of glossy eggs laid by their offspring would throw more light on the problem. Unfortunately only two of the males used had any degree of variation in the phenotypes of their mates. These matings are shown in Table III, which strongly suggests the existence of modifying factors, since there appears to be some relation between the variations of daughters and dams of the same genotype.

Speculation regarding mode of action of such modifying factors is not warranted beyond the suggestion that one major pair of genes may be responsible for determining on which side of the 50 per cent threshold the shell finish of eggs laid by any bird will fall. The limited evidence from the Hamburg-Minorca crosses restricts this conclusion to the particular flock of Leghorns studied.

Summary

The difference between chalky and glossy shell finish, which is probably related to the amount and distribution of the cuticle of the shell is described and illustrated. In the flock of Single Comb White Leghorns studied chalky finish acts as a dominant to glossy finish. It is suggested that one pair of genes has a major influence in determining the shell finish of eggs laid by a bird. There is, however, evidence of factors modifying the expression of these major genes.

◆

Racial Factors in the Hawaiian Labor Situation

(*Continued from page 25*)

their wealth was passed on by inheritance, it accumulated in the hands of fewer and fewer persons, hence contributing to the maintenance of a stronger individual economic position than would otherwise have been the case.

Again, because of historic relationships, the Territory tends to favor the employment of Hawaiians in government positions.

The economic position of the Portuguese in this second group is much less clear, and subject to exceptions.

Because the Chinese arrived earlier than the great majority of oriental migrants, they had the advantage of having established themselves in strategic positions early in the period of economic expansion. The Japanese, on the other hand, have the advantages of large numbers and great racial solidarity. Thus, although the economic position of the Japanese is, on the average, somewhat lower than that of the Chinese, they have established themselves very securely in the Hawaiian economy.

The Filipinos, of all the large racial groups, occupy the least advantageous economic position and have a distinctly uncertain future in Hawaii. They are subject to all of the disadvantages of a late migrant to an already industrially developed community. Thus, in proportion to their numbers, they occupy far fewer salaried and executive positions than do members of other races. In addition to having a lower average wage level, they are faced with the social instability which grows out of the great preponderance of Filipino men. For other racial groups, normal social organization along family lines is typical, whereas for Filipinos, single men (the overwhelming majority of them living in groups in plantation houses) are typical. Their social conditions are thus distinctly unsatisfactory from a long-run point of view. In recent years, far more Filipinos have returned to Manila than have migrated to the Territory.

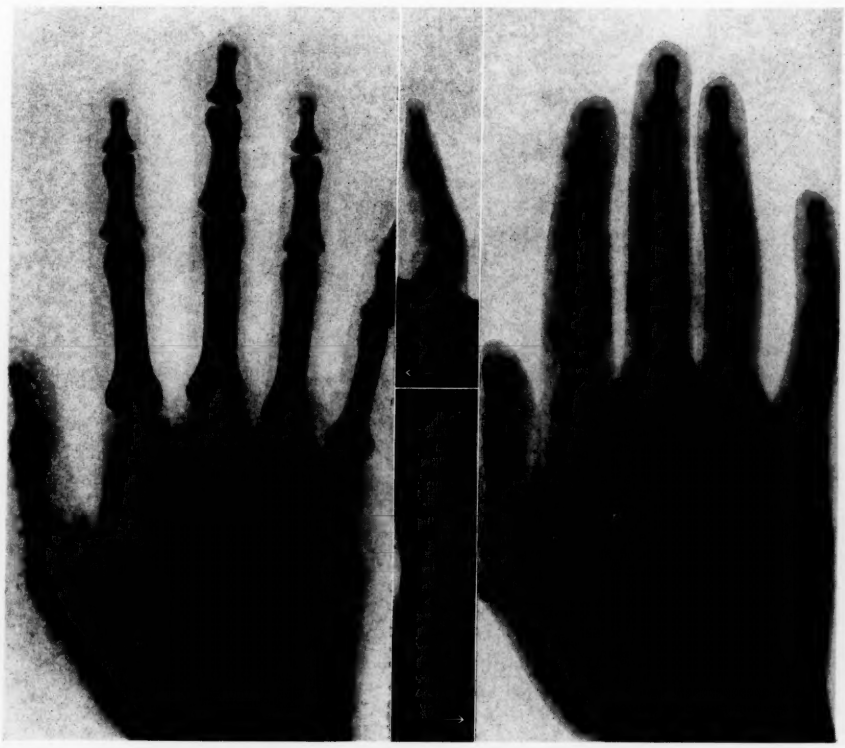
Wages as related to racial origin of owners and managers.—Another generalization closely related to racial differences in wages is that the wage structures of individual concerns, broadly speaking, tend to stratify in accordance with the racial origins of the owners and managers of such concerns. For example, the differences in wages paid by companies in the printing and publishing industry are even greater than the differences in the average earnings of employees classified by race. Although there are significant exceptions, it is true that in the oriental companies average earnings are lower, average hours are longer, and working conditions are generally poorer than in establishments under Caucasian man-

(*Continued on page 44*)

CROOKED LITTLE FINGERS

(Minor Streblomicrodactyly)

R. A. HEFNER



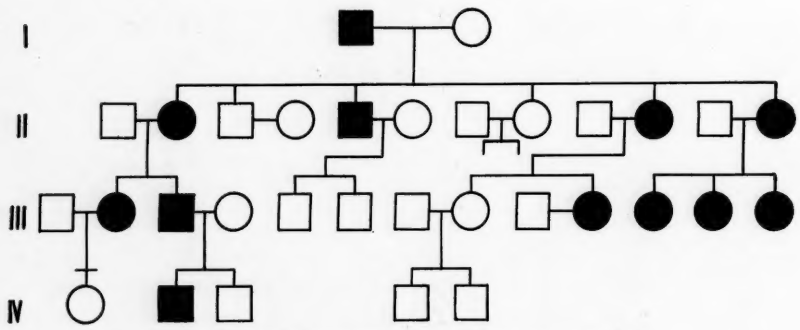
X-RAY OF CROOKED LITTLE FINGERS

Figure 14

The right hands of two sisters showing the uniformity of the trait. The little fingers are re-shown in side views in the center insert. The left hands of these persons showed a like effect of the trait.

TWO earlier reports on crooked little fingers[1] (Streblomicrodactyly)[2] emphasized the uniformity of the characteristics in two unrelated family lines. Not only was the condition confined to the little fingers but the degree of flexure was remarkably uniform and all hands exhibiting the bent little fingers in these studies were decidedly dolicodactylous.

The present investigation deals with a family in which crooked little fingers exhibit less flexure than those of the previous studies and the condition is consequently designated as *Minor Streblomicrodactyly*. The trait is constant both as to degree and direction of bending in the four generations here presented (Figure 15). The underlying



FOUR GENERATIONS OF DEFLECTED DIGITS

Figure 15

The chart shows the distribution of crooked little fingers through four generations. The mode of inheritance is clearly that of a simple Mendelian dominant trait.

causes must be similar to those reported in earlier studies, viz., a short tendon of the flexor digitorum muscle which controls the little finger, attended by some distortion of the proximal phalangeal bone. The effect on the bone is less pronounced since only a slight curvature at the distal end of the proximal phalanx is discernible in the X-ray prints. (Figure 14.) Dolicodactyly is noticeable in the hands but the condition is less pronounced than that shown by the subjects of the earlier studies. The mode of inheritance of minor streblomicrodactyly is clearly that of a simple mendelian dominant trait transmitted directly by a heteozygous parent to one-half the offspring.

The minor nature of this trait is obvious. Few persons would notice the bent little fingers unless attention was directed to them and no functional disorder attends the condition. The main interest in the heredity of this minor condition lies in its marked constancy and its possible relation to the type of crooked little fingers described earlier. Since both are inherited as monogenetic traits and each type is constant as to degree, there is a strong suggestion of multiple alleles in the relations of the normal condition and these two types of streblomicrodactyly. In the absence of hereditary lines exhibiting both types, this suggestion is purely conjectural.

Literature Cited

1. Hefner, R. A. Subterminal Articulation in the Proximal Joint of the Little Finger. *Jour. Hered.*, Vol. XV, No. 12. 1924.
2. ————————. Inheritance of Crooked Little Fingers (Streblomicrodactyly). *Jour. Hered.*, Vol. 20, No. 8. 1929.
3. Stoddard, S. Edmund. Nomenclature of Hereditary Crooked Fingers. *Jour. Hered.*, Vol. 30, No. 11. 1939.

X-RAY STUDIES ON THE FIELD BEAN*

CLARENCE F. GENTER AND HUBERT M. BROWN†

SINCE the discovery of x-rays by Roentgen in 1895, many investigations have been carried on to determine their effects upon biological organisms. In 1938, a study of this type with field beans (*Phaseolus vulgaris*) was begun at Michigan State College. The information obtained to the end of the crop season of 1939 is herein reported. The objectives of this x-ray experiment were to determine the types of mutations that might be produced in white pea beans and the rates of these mutations in both dormant and germinating seeds.

Muller,[9] working with Drosophila, first discovered the genetic effects of x-ray treatments and reported on them in 1927. Shortly thereafter, Stadler[10] first reported similar effects in plants (barley).

The types of mutations which have been found in progenies from treated plant material include large numbers of chlorophyll deficiencies,[8,12] modifications of vegetative or floral parts[4,5,6,8,11,12] and lethals.[12] Almost all induced mutations have been unfavorable to growth, and all have been recessive.[8,12]

Methods

Seeds of the Michelite[3] variety of *Phaseolus vulgaris* were used. The beans were graded and hand-picked to produce a uniform lot of seed, and were then divided into three groups for treatment. One group was left dormant, a second was germinated for 18 hours before treatment, and the third was germinated for 36 hours before treatment. The beans were placed approximately 13 cm. from the target of a Coolidge cathode x-ray tube operating at 100 K. V. and 10 m.a. and were air-cooled with an electric fan. The first two groups were irradiated for periods of 5, 15, 30 and 60 minutes, while a single treatment of 12 minutes was given to the beans of the third group. The treatments, with the dosages calculated in *r*-units are summarized in Table I.

The seeds were planted in a clay loam field (Conover type) within two hours after the treatments were given. The seeds were spaced three to four inches apart in 28-inch rows. Plantings were made on the following dates in 1938: all dormant seeds, treated and untreated, on June 8; all seeds germinated 18 hours on June 9; and all seeds germinated 36 hours on June 10. On each of those dates, heavy rains fell either during the actual planting or within a few hours afterwards. This crusted the soil and undoubtedly affected the number of seedlings that broke through the ground and survived.

The Treated Generation

The effects of the x-ray treatments were first noted shortly after the seedlings began to come through the ground, when many of the seedlings came up, straightened their stems, but failed to develop apical buds. These plants remained in this condition for a week or ten days and then died. Their roots were found to be short, thick and swollen. The root-tips had also apparently failed to grow normally and finally rotted. This almost complete inhibition of growth was similar to "delayed killing"[2] and might possibly have been due to a diminution of Vitamin B_1 or to chromosomal aberrations.[7] No cytological studies were made. On June 27, the number

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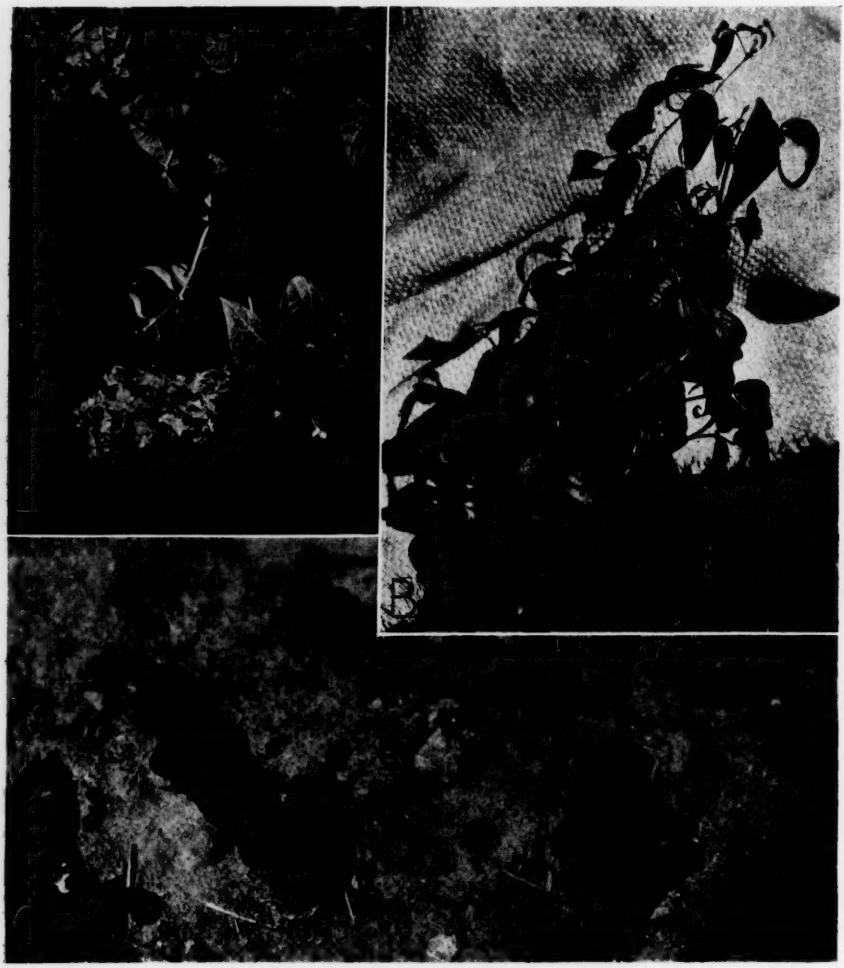
†Formerly Graduate Student in Farm Crops, Michigan State College and Research Assistant in Farm Crops, Michigan Agricultural Experiment Station, respectively.

The authors are indebted to the Department of Physics for the use of its x-ray apparatus, and in particular to Dr. J. C. Clark who directed the x-ray treatments.



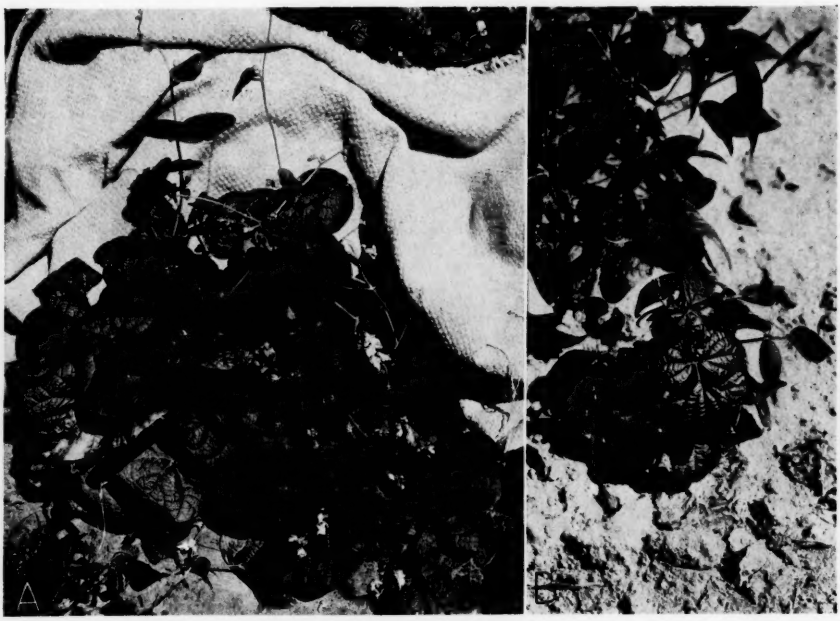
THREE MUTANT TYPES

Figure 16

A—Small bushy plant with very small leaves. The primary leaves were very light green. Large leaves belong to adjacent normal plant. *B*—"Willow leaf" type with long narrow leaves. *C*—Erect cylindrical type with leaves smaller and rougher than normal.

of plants that were above ground and apparently healthy ("living") and the number that had emerged but died soon after emergence ("dead") was counted. The sum of these two numbers when subtracted from the number planted gave the number of seeds which had failed to come through the ground ("not up").

The numbers of "not up" and "dead" increased directly with, but not uniformly in proportion to, the length of treatment. Germinating seeds were, in general, more severely injured than were dormant seeds with the same treatment,



MUTATION IN LEAF SHAPE

Figure 17

A—Rounded leaves characterize this mutation and the number of leaflets vary from one to three. These plants were completely sterile. *B*—Small, glossy plant showing the football shaped center leaflet and with the petiole of the leaf winged.

agreeing somewhat with Stadler's findings in barley.[11] The seeds that had been germinated for 36 hours before the treatment was given were much more severely injured by the 12-minute exposure than were the seeds that had been germinated eighteen hours by the 15-minute exposure or the dormant seeds by the 30-minute exposure.

The continued inhibitory effects of the x-rays on the plants that survived were evidenced by their stunted growth. The five-minute treatments gave only a slight stunting effect, but the stunting became progressively more severe as the length of treatment increased. The germinated groups again showed more severe injury than did the dormant groups. At the end of three or four weeks, many of the plants in the lightly treated lots had apparently recovered from the stunting effects of irradiation and grew normally, but they never quite caught up to the untreated plants in size. The plants in the more heavily treated lots were severely retarded and grew slowly throughout the spring and early summer.

No differences were found in the shape or structure of the leaves or plants of the treated material other than that due to the slow growth of the retarded plants.

Later, after a period of wet weather set in, many of the heavily treated plants began to grow vigorously and several set a heavy crop of seed. In the fall, the plants grown from treated seed were quite characteristically spotted by the dark green foliage of late-maturity. The untreated controls matured much more evenly and a majority of the plants matured much earlier than did the treated

plants. Because there was so much variation in the time of maturity of the treated material, a record was kept of the harvest date of each plant.

The pods were dried and later threshed. The number of seeds per plant from all of the treated material and from the untreated lot of dormant seeds was recorded. There were no significant differences in the average numbers of seeds per plant in any of the treated material.

The Second Generation

In the spring of 1939, a total of 1,434 progenies was planted. The seeds were spaced about three inches apart in 28-inch rows. Most of the progenies were planted June 7, just before a rain, and the remaining lots two days later.

Observations were made every few days during emergence and immediately thereafter, and at longer intervals as the season progressed. Only well-defined variations were classed as mutant types. A total of 152 progenies showed mutants, involving a large variety of forms. The mutations that were apparently the same, have been grouped together to give the following classification:

No. of progenies	*Description of mutant type*
	(*a*) *Died soon after emergence*
29	Yellow seedlings
13	White seedlings, entirely lacking in pigment
9	Light green seedlings
51	
	(*b*) *Lived for a few weeks, then died*
8	Light green seedlings, light green secondary leaves
2	Light green seedlings, several very bright yellow secondary leaves
2	Yellow primary leaves, and yellow secondary leaves
1	Dwarf squat plants, rosette in form
13	
	(*c*) *Lived until harvest time, dwarfs or small plants*
1	Light green seedling; many small secondary leaves; Figure 16*A*
1	Yellow edges and veins on secondary leaves
15	Dark, glossy green; veins distinctly indented
12	Leaves long and narrow, "willow leaf" type; Figure 16*B*
1	Narrow primary leaves
3	Thick leathery leaves, slow in growth
4	Bushy plants with small rough irregular leaves
1	Mottled primary leaves
7	Plants 4 to 7 inches high with leaves proportional in size to plant size
1	Leaves with 5 leaflets instead of 3
1	Erect dense, cylindrical in form; dark glossy green color; plants 3 to 10 inches high; Figure 16*C*
3	Dark green slender vine, no branching
50	
	(*d*) *Lived until harvest time, near normal or normal in size of plant*
6	Green primary leaves; light green secondary leaves
6	Light green primary leaves; secondary leaves light green when first formed but turn darker green with age
4	Yellow primary leaves, light green secondary leaves
3	Yellow primary leaves, dark green secondary leaves
1	Secondary leaves light green along veins; viny; leaves somewhat smaller than normal
2	White chimeras
3	Mosaic appearance to leaves; plants normal weight, but slender
2	Seedlings very erect and tall; very erect later growth
4	Long narrow leaves, but wider than "willow leaf" type and angular
4	Many slender branches
1	Rounded leaves; number of leaflets varies from one to three; Figure 17*A*
1	Center leaflet football shape; attachment to petiole flat; Figure 17*B*
1	Stems appear very susceptible to rust; tips of vines green with the rust becoming progressively worse down the stem
38	

Approximately 67 per cent of the mutant types exhibited chlorophyll abnormalities. Some 42 per cent died in the seedling stage or soon afterward. Of those which survived until harvest time, some 57 per cent were dwarfs or small plants and the others remained less than normal in size despite the fact that the progenies showing mutations were thinned to give the mutants more favorable growing conditions. More than 90 per cent of the mutants were distinguishable within the first five weeks after emergence.

In the progenies showing mutant

Table I. The length of treatment in minutes, the dosage in r-units, and the condition and number of seeds treated.

Length of treatment in minutes	Approximate dosage in r-units	Number of seeds Treated		
		Dormant	Germinated 18 hrs.	Germinated 36 hrs.
0	0	300	200	200
5	2,160	400	400	-
12	5,250	-	-	400*
15	6,500	400	400	-
30	13,000	400	400	-
60	26,000	400	400	-

*The x-ray tube burned out and terminated this series of treatments.

Table II. Number of progenies planted in 1939 (upper figure) and number of mutations (lower figure) for each date of harvest in 1938. The average per cent of mutation per treatment and per harvest date is also given.

Treatment in minutes	Date harvested in 1938								Per cent of mutations
	9/14	9/15	9/17	9/20	9/30	10/6	10/13	Or* Total	
	Seeds dormant when treated								
5	7 1	40 *2	27 1	52 3	29 0	15 2	26 1	0 196 0 10	5.1
15	17 0	24 2	16 4	46 6	42 2	26 0	47 4	0 238 0 20	8.6
30	0 0	1 0	5 2	5	25 8	25 7	109 12	2 166 0 30	17.9
60	0 0	0 0	0 0	0 0	12 6	8 5	29 7	13 62 1 19	30.7
	Seeds germinated 18 hours when treated								
5	80 1	25 0	25 1	50 3	51 3	9 1	78 3	1 322 0 13	5.0
15	9 4	9 3	8 2	28 3	18 2	30 3	67 10	0 169 0 27	8.0
30	1 0	7 1	6 0	15 0	12 0	8 2	41 1	5 95 1 5	5.5
60	0 0	1 1	2 0	0 0	10 3	8 2	22 6	6 49 0 12	24.5
	Seeds germinated 36 hours when treated								
12	18 0	25 1	16 0	34 1	45 5	31 2	30 7	3 200 0 16	8.0
Totals	72 6	134 10	105 10	235 19	239 38	171 25	449 51	30 1434 2 152	10.6
Per cent of mutations	8.3	7.5	9.7	8.1	11.7	14.5	11.4	6.7 10.6	

* Transplanted from field to greenhouse September 1, 1938.

Table III. Number of progenies of the various sizes which were planted (upper figure), number of progenies with mutations appearing in each size (lower figure), and per cent of mutations in each size.

Treatment in Minutes	Number of seeds per progeny							Per cent of mutations
	1-10	11-20	21-30	31-45	46-70	Over 70	Total	
	Seeds dormant when treated							
5	13 0	26 0	34 0	40 2	83 8	0 0	196 10	5.1
15	12 0	32 2	29 5	54 3	86 9	20 1	233 20	8.6
30	40 0	27 2	20 3	31 5	35 12	15 8	168 30	17.9
60	19 1	2 0	8 0	9 1	11 7	13 8	62 19	30.7
	Seeds germinated 18 hours when treated							
5	20 0	23 2	47 3	65 3	91 5	14 0	282 13	5.0
15	15 1	22 3	22 5	35 6	59 7	19 5	169 27	16.0
30	11 1	16 0	16 1	25 3	12 0	15 0	95 5	5.3
60	7 0	8 0	4 1	7 4	5 0	16 7	48 12	25.5
	Seeds germinated 36 hours when treated							
12	14 0	22 1	17 1	85 5	42 5	40 2	200 16	8.0
Totals	153 1	178 12	197 19	311 28	421 53	174 31	1434 152	10.6
Per cent of mutations	1.7	6.7	9.6	10.9	12.5	17.8	10.5	

types, the ratio of number of mutants to total number in a progeny varied greatly and ranged from one extreme of 1:1 or 3:5 in the smaller plots, and 8:34 or 13:42 in the larger plots, to the other extreme of 1:63 or 2:105.

Table II gives the number of progenies showing mutations, with the progenies grouped according to their parental harvest date in 1938. There is an indication that the later the maturity of the plants of the treated generation the higher the percentage of mutating progenies, suggesting that the amount of injury, as reflected in delay in maturity, might be correlated with the percentage of mutation. On this assumption, it could be concluded that, if the environment had been favorable so that the weakest plants in the treated generation could have produced seed, the per cent of mutant progenies, especially in the heavier treatments, would have been much greater than was observed.

The regular increase in the rate of mutation as the size of the progeny increased, Table III, was probably due to the chimeric condition produced in the affected plants of the treated generation. The larger the number of seeds produced, the greater the likelihood that the seeds produced by the affected sector would contain one or more seeds homozygous for the mutant factor.

Most of the mutating progenies showed only one type of mutant but 11 progenies showed two types of mutants each (similar to results in barley[12]).

Only one of the 160 control progenies planted showed any type of segregation, which tends to indicate that the material was rather uniform and that the high numbers of mutants were due to the treatments.

During the summer many of the more outstanding mutants were so staked that at harvest time, which was in mid-September, they could be found and saved. Only a few produced seed and they were later in maturity than the normal plants.

Summary

Lots of dormant and germinated white pea bean seeds were x-rayed with four

dosages: 2160, 6500, 13000, and 26000 γ-units.

The effects of the irradiation upon the treated generation varied directly with the dosage and with the length of germination period prior to treatment as measured by (a) the number of seeds that failed to break ground, (b) the number of seedlings that died within 19 days after planting, and (c) the retardation of growth and development of the plants.

Ninety per cent of the many different types of mutations observed in the second generation were distinguishable within five weeks after emergence. Approximately 67 per cent of these types were chlorophyll abnormalities. Other characters affected were plant size, branching, leaf size, shape and texture, fertility and earliness of maturity. The rate of mutation varied roughly with the dosage and the length of germination period prior to treatment and tended to increase with the later harvest dates and size of progeny.

The great variability in the mutant ratios indicates that the x-rays produced sectorial variations in the treated plants rather than affecting the entire plant.

Literature Cited

1. Cattell, W. The effects of x-rays on the growth of wheat seedlings. *Science* 73: 531-533. 1931.
2. Collins, G. N., and L. R. Maxwell. Delayed killing of maize seedings with x-rays. *Science* 83:375-376. 1936.
3. Down, E. E., and J. R. Thayer, Jr. The Michelite Bean. *Mich. Agri. Exp. Sta. Spec. Bul.* 295. 1938.
4. Goodspeed, T. H. Cytological and other features of variant plants produced from x-rayed sex cells of *Nicotiana tabacum*. *Bot. Gaz.* 87:563-582. 1929.
5. ———— and A. R. Olson. The production of variation in Nicotiana species by x-ray treatment of sex cell. *Proc. Nat. Acad. Sci.* 14:66-69. 1928.
6. Horlacher, W. R., and D. T. Killough. Somatic changes induced in *Gossypium hirsutum* by x-raying seeds. *Jour. Hered.* 22:253-262. 1931.
7. Komuro, H. Cytological and physiological changes in *Vicia faba* irradiated by Roentgen rays. *Bot. Gaz.* 77:446-452. 1924.
8. MacArthur, J. W. X-ray mutations in the tomato. *Jour. Hered.* 25:75-78. 1934.
9. Muller, H. J. Artificial transmutation of the gene. *Science* 66:84-87. 1927.
10. Stadler, L. J. Mutations in barley induced by x-rays and radium. *Science* 68:186-187. 1928.
11. ————. Genetic effects of x-rays in Maize. *Proc. Nat. Acad. Sci.* 14:69-75. 1928.
12. ————. Some genetic effects of x-rays in plants. *Jour. Hered.* 21:2-19. 1930.

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Racial Factors in the Hawaiian Labor Situation

(*Continued from page* 36)

agement. This tendency appears to be one of the reasons why fields of work dominated by oriental firms—such as private construction, the small retail shops, barber shops, and dressmaking—tend toward distinctly lower labor standards than other fields.

* * * *

Viewpoints of Hawaiian-Born Workers

Conferences with Japanese, Chinese, and Filipino young people's organizations in the Territory led to the conclusion that, whether justified or not, these young people held certain definite impressions in respect to their own future prospects, as follows:

(a) For the overwhelming majority of them Hawaii offers the only possible economic future. American-born Japanese are not welcomed in Japan, but are rather looked upon with suspicion and as undesirable competitors. Indeed, it is not at all uncommon to encounter Japanese who can speak only English and who consider themselves distinctly American, with no ties whatsoever with the country of their origin.

Chinese young people do not arouse such a hostile attitude in their home country as do the Japanese, but the wages and working conditions of China are on such a distinctly lower plane than those of Hawaii that they do not think of their homeland as an alternative. The destructiveness of the war in China since July 7, 1937, has been such that anything like normal economic conditions do not appear likely there for at least a generation. * * * *

Filipino young people are in a somewhat different position since, as latecomers, they occupy the lowest position economically in Hawaii. Since the great majority of them are migrants from the Philippines, rather than Hawaiian-born, many of them still retain contacts in the Philippines and large numbers have returned during the past decade. Reports indicate that wages and working conditions in the Philippines are on a distinctly lower lever than those of Hawaii, and this is acting as a deterrant to those who contemplate a return.

AN UNUSUAL CASE OF BRACHYDACTYLY*

BERNARD N. E. COHN and ABE RAVIN

THE manifestations of brachydactylia are legion. Attempts have been made to classify the various deformities in order to obtain a better understanding of their nature[1,2]. The following case is of interest because it presents several unusual features.

The patient, a white female, age nine years, was a spontaneous birth, and was the youngest of five children. At birth adduction of the index fingers and the large toes was observed, the relative lengths of the affected fingers and toes being approximately normal. She was bottle fed with an adequate diet from birth. When she was 18 months old the mother first noted that the child was backward, inactive and did not play like other children. At the age of three years a diagnosis of hypothyroidism was made for which she has since been given thyroid extract, apparently responding well to treatment. Repeated Wasserman reactions on the patient, mother and other children in the family were negative. Besides the usual childhood diseases, the past history revealed a tonsillectomy followed by severe hemorrhage, necessitating a transfusion in 1932. She had pneumonia in 1933.

The child weighed 47 pounds and measured 4′ 1″ in height. The facies appeared somewhat dull, although she responded alertly to questioning. The hair was abundant and normal in texture. A highly arched hard palate was noted. The thyroid gland was not palpable. The thorax was long and narrow, the sternum appearing abnormally short with undue prominence of the caudad end. The general physical examination was otherwise essentially negative.

The orthopaedic examination revealed that the index fingers of both hands were considerably shorter than normal, barely extending to the distal phalangeal joint of the third fingers (Figure 18). A moderate valgus deviation at the metacarpophalangeal joint was noted. Each index finger consisted of three distinct phalanges. No limitation of motion either of the metacarpophalangeal or the phalangeal joints was found. The nails were not abnormal in appearance or texture. The remaining fingers of both hands were entirely normal. The metacarpals were not short.

Examination of the feet revealed a marked valgus deviation of both first toes (Figure 19). The second toes overlapped the distal ends of the first toes. The big toes not only appeared shorter than normal due to the valgus deformity but also were decreased in length by actual measurement. Contracture of the extensor hallucis longus tendon was present. Limitation of flexion and extension of the metatarsophalangeal joints was noted. There were no abnormalities of the nails. The remaining toes were negative. The metatarsals were normal in length.

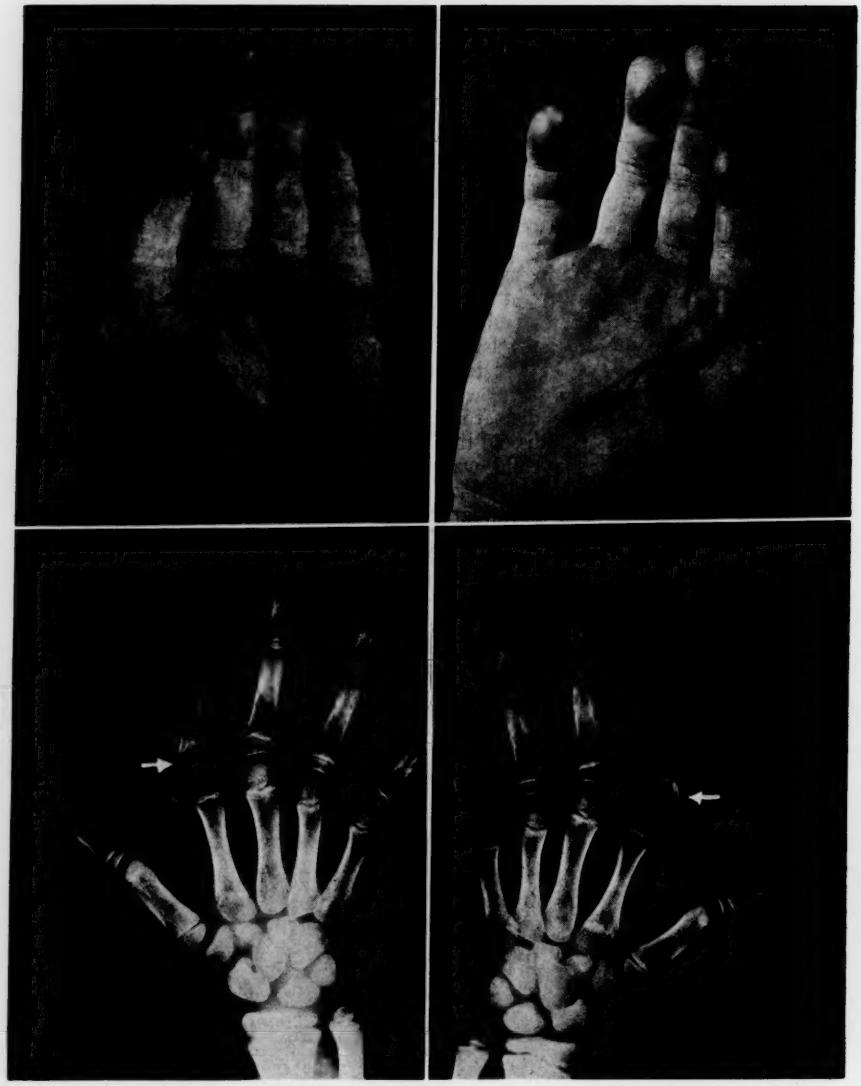
The spine showed a mild degree of scoliosis classified as congenital in origin because the physical examination revealed no other etiologic basis. No other congenital abnormalities were found.

Roentgenographic Examination

What appears to be the epiphysis of the proximal phalanx of each index finger is triangular in shape, especially the left (Figure 19.) The radial side of the proximal end of the first phalanx presents a ledge which projects over the triangular epiphysis, imparting a broadened appearance to the phalanx. This ledge appears as though it might be a fusion of a triangular extra bone with the base of the phalanx. All the phalanges of the index fingers are short.

The middle fingers present a some-

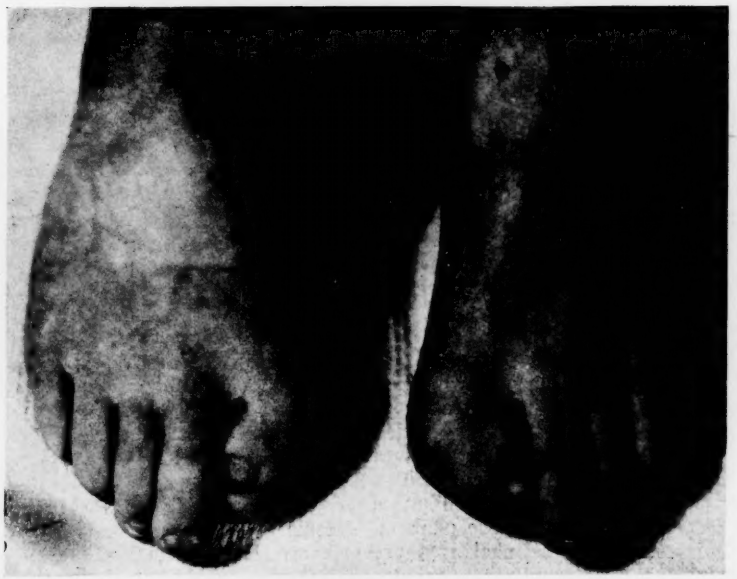
*From the Orthopaedic and Medical Outpatient Departments, University of Colorado School of Medicine, Denver, Colo.

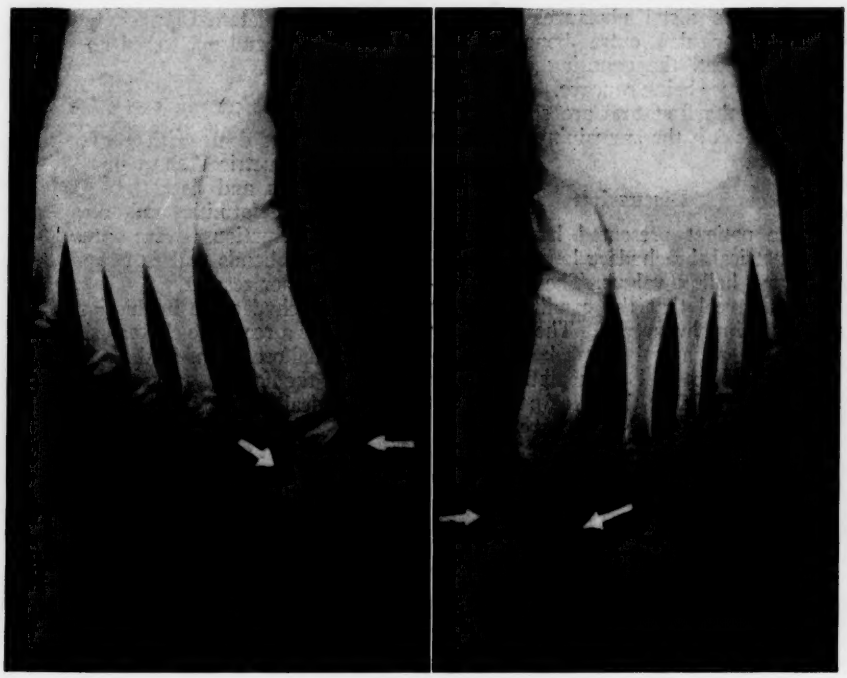


DEFORMED INDEX FINGERS

Figure 18

The index fingers of both hands are shortened and twisted in a characteristic manner. The x-rays show that the structure of the proximal phalange is abnormal. A similar peculiarity is to be noted in the big toes.





BIG TOES AFFECTED

Figure 19

External view of the feet and x-rays of the toes. These show that the big toes have an abnormal development of the phalanx somewhat comparable to that of the index fingers. The second toe, which is the homologue of the index finger is normal. The fact that both hand and feet are affected strongly suggests a genetic basis for the defect. It was not found in any of the patients' ancestors, so that must be either recessive or a mutation.

what suggestive triangular shape of the proximal epiphyses. The corresponding epiphyses of the fourth and fifth fingers are normal in shape. There is no decrease in length of the metacarpals. The first and second metacarpals have epiphyses at both ends. The development of the carpals corresponds to that of a nine year old girl indicating that there has been no delay in development as a result of hypothyroidism.

The roentgenograms of the feet reveal similar findings (Figure 19). The adduction deformity is clearly shown. The proximal phalanges of the first toes consist of two well-demarcated bones which dovetail neatly together, the extra bones being roughly triangular in shape. These bones appear to be somewhat more coarsely trabeculated than the phalanx. No epiphyses of these phalanges are present unless one assumes that the extra bone might be an epiphysis. The epiphyses of the distal phalanges reveal a small, triangular extra bone on the lateral aspect, the apposing surface of the epiphyses being concave. Both phalanges of the first toes are short. The phalanges of the remaining toes are negative.

Discussion

The patient presented has bilateral, symmetrical, brachydactylous index valgus and hallux valgus. The roentgenograms reveal that the condition is not a simple brachydactylia. The triangular bones are apparently extra bones resulting from abnormal segmentation of the digital mesoblastic tissue, as pointed out by Drinkwater.[3] This interpretation receives some confirmation from the observation that the valgus deformities were very evident at birth; the brachydactylia, on the other hand, became manifest with age, as is usual in simple brachydactylia. It is probable that in time the extra bones will completely fuse with the proximal phalanges; the resulting abnormal shape of these phalanges will then be the only indication of the hypophalangia which is evident at present.

It has been shown that brachydactylia is usually transmitted as a dominant characteristic. The deformities in this case, however, are apparently recessive. Physical and roentgenographic examinations of the mother and the other children of the family failed to reveal any skeletal malformations. Although the mother had been married for years at the time of the patient's conception, she maintains that her husband is not the father of the child but was the result of an extra-marital love affair. The father was not available for examination. However, the mother denies that he had any deformities of the hands or feet. It seems logical to assume that if he had abnormalities similar to those of the patient, they would have been very apparent even to a layman. Genealogical study of the maternal branch and of the mother's husband uncovered no skeletal malformations.

Summary

This report deals with a case of bilateral, symmetrical shortening of the index fingers and first toes combined with valgus deformities and extra bones. The malformations were present at birth. The hands and feet are normal in every other respect.

The brachydactylia in this instance is apparently a recessive characteristic. No similar malformations in the other members of the family or in the maternal genealogical tree were found.

Literature Cited

1. MacArthur, J. W., and McCullough, E. Apical Dystrophy. An Inherited Defect of Hands and Feet. *Human Biol.* 4:179, 1932.

2. Pol. "Brachydaktylie" — "Klinodaktylie" — Hypophalangie und ihre Grundlagen. *Virch. Arch.* 229:388, 1920-21.

3. Drinkwater, H. Hereditary Abnormal Segmentation of the Index and Middle Fingers. *J. Anat. and Physiol.* 50:177, 1916.

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